The QUARTERLY BULLETIN

MICHIGAN STATE COLLEGE
Agricultural Experiment Station
EAST LANSING . . . . . MICHIGAN

VOLUME 31 . . . . . MAY 1949 . . . . . NUMBER 4

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8 - AUG. 1949

V. R. GARDNER, Director . . . . . *J. G. DUNCAN, Editor*

THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents: 1) progress reports on long-term major research projects; 2) final reports on short-term projects and 3) short, timely articles of a popular nature that bring together information from various sources on subjects in which farmers are interested.

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CORN BREAD OR PORK CHOPS?

By LARRY BOGER and ARTHUR MAUCH
DEPARTMENT OF AGRICULTURAL ECONOMICS

BULGING GRAIN BINS have long been a symbol of plenty. But bulging grain bins also have caused us a lot of trouble. In the years ahead this symbol should be changed. The health and well-being of the people should become the best sign of abundance. This would require a better diet for all of the people—more meat, milk and eggs. But we can't have this better diet with our present price support program for agriculture. Why are we supporting the price of some of our grains at levels that prevent their use as feed? Why don't we encourage the use of these grains as feed by removing price supports on them and supporting only livestock and livestock product prices? At the same time we would have the best answer to our grain surplus problem.

Those who represent us in Washington will be making decisions in the next few months on a program for agriculture that will be felt for years to come. They are vital decisions. Will agriculture get high support prices, with their inevitable twin, production or marketing control—or will it get flexible supports that attempt to keep production in line with consumer needs?

Hearings have already begun. Alignments have been made. Pushing for, or at least leaning toward, flexible price supports are the Farm Bureau, the Grange, and the National Council of Farmer Cooperatives. Strong for high support prices are the Farmers' Union and the local committeemen of the Production and Marketing Administration (Triple-A to most of us). They will be joined by those representing wheat, cotton, and tobacco since "balanced" production would mean considerable adjustment in their areas.

Each of these groups can see a "mandate" in the results of the November election. Before any decision is made let's stop and think over some of the real issues. We can then better decide whether we want flexible supports, rigid supports at a high level, or some other

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approach. But keep in mind that we should strive toward balanced production and consumption at a level satisfactory to consumers and at the same time provide an adequate income for farmers.

We all like to live in a land of plenty and prosperity. We like to have enough money to buy the things we need. On top of those things we really need, we want to have some other things. The horse and buggy used to take us places—now we want a car. We used to use oil lamps—now we want electricity. By the same token we can eat cereal products and survive, but we enjoy T-bone steaks, milk, eggs, and other livestock products. When all of these wants or needs are attained, they add up to a higher standard of living.

Soil conservation will be further emphasized with an increased production of livestock. Many of our crop acres will be seeded to grass. Livestock numbers will be increased to utilize the additional pasture. In turn, the manure from the livestock will increase the fertility of our cropland. It all adds up to further conservation of our resources and higher productivity.

PAST PROGRAMS

Most of us remember the type of agricultural programs we tried during the late 'twenties and through the 'thirties. The general idea of all the programs was to control the supply and strengthen prices. In spite of these efforts, production continued high and prices low. On top of this, we began to accumulate huge stocks of grain. These stocks

Fig. 1. High support prices for grain lead to grain surpluses, less livestock, and a less satisfying diet.

became known as surpluses, and at the outbreak of the war they amounted to almost one year's production.

It was good to have these large surpluses because of the war, but in normal times they are a real burden. But a support program for livestock alone would not entirely neglect this phase of security. First of all, we will have to provide for a minimum annual carry-over of grains in order to maintain feed supplies in years of poor crops. But in times of real emergency we could market more of our livestock and release still more grain for human food. We would have more meat to eat during the emergency, and at the same time, feed more people with the extra grain.

FEEDING SURPLUSES

For the years since 1930 an increase of about 2 percent in livestock numbers would have been more than enough to use our stocks of wheat. In fact, our country would have found herself with no stocks of wheat by 1935. If we would have used corn when we ran out of wheat, our corn stocks by 1943 would have been only about half what they were.

But how much more of these products would we have had to eat? If all of the increased production had been in hogs, we would have eaten about one more meal of pork each month. If all of it had been

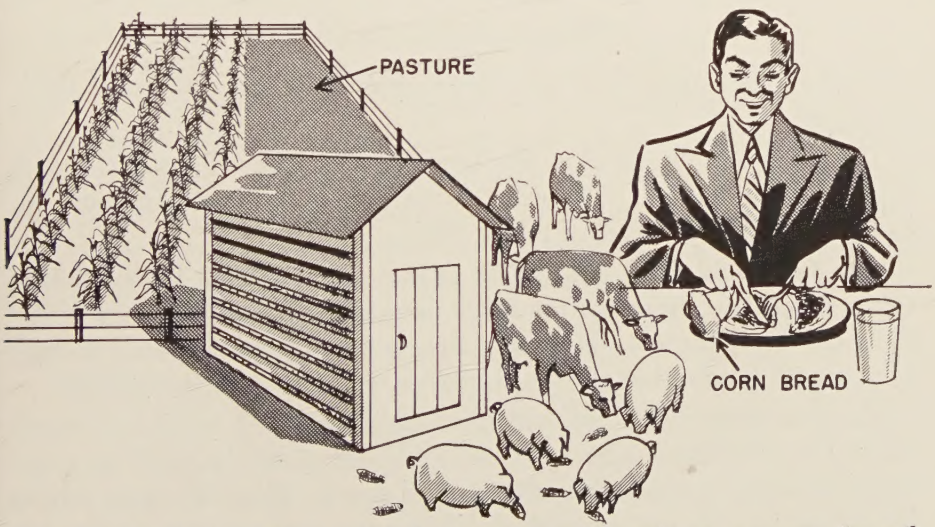

Fig. 2. Emphasis on livestock will eliminate grain surpluses, conserve the soil, and improve the diet.

in milk production, we would have consumed about one more quart a week. But of course we should not assume that all of the increase came in the same product. The following table illustrates how much more of all these products we would have eaten per person each year with a 2-percent increase in livestock numbers.

Milk	7 quarts
Beef	1 pound
Pork	1.2 pounds
Eggs	½ dozen
Chickens, Turkeys, and Lambs	1 pound

These figures are relatively small, and the expansion of livestock numbers probably could have taken place easily. Livestock numbers could have been expanded in the Great Plains, in parts of the South, the Pacific Northwest, and even in the Corn Belt where the greatest concentration of livestock now exists.

We can assume, then, that livestock production will be expanded if prices are favorable. This means that livestock will use more grain and reduce our worries about surpluses. Consumers and producers both will benefit. Consumers will have more livestock products to eat, and producers will be assured of a reasonable minimum price for livestock. The increased demand for livestock feed will be reflected in the prices paid for grain.

OTHER OBJECTIVES

Three other objectives of an agricultural program to reach these goals are:

1. A favorable relationship between feed and livestock prices should be maintained. The exact ratios should be determined on the basis of the desired level of production.

2. **Food** and **fiber** crops that cannot be marketed through livestock should be supported at levels low enough to encourage shifts to livestock production. However, the supports should be high enough to maintain production at a level necessary to meet our real needs.

3. Provision should be made for some carry-over of grain in years of high production. These stocks could be partially used in years when there is a temporary shortage of feed. Most of these stocks should be kept in the grain production areas and transferred directly to feed shortage areas to keep freight costs down.

PRESENT LAW

The changes made in the price support program to become effective in 1950 represent a big improvement over past programs. Emphasis has been shifted somewhat from grains to livestock and livestock products. But the flexible provisions of the new act may not be flexible enough to prevent surpluses and the inevitable production or marketing controls. On the other hand, if the provisions of the new act were made much more flexible, the prevention of a drastic drop in prices might be difficult. This might be true even though national income remained fairly stable. Something more is needed to assure the use of our excess grain production.

DANGERS OF FUTURE SURPLUSES

But—are there dangers of future surpluses? Prior to this last war, a billion bushel wheat crop was almost unheard of. In fact, the only time we had a billion bushels of wheat was in 1915. But we have produced a billion bushels or more each year since 1944. The year 1947 set a record with 1,365 million bushels—more than 50 percent higher than the average for the last 25 years. For the past six years we've had plenty of wheat for ourselves, as well as sizeable amounts left over to export. Wheat exports the last two years have been three and one-half times as much as the average for the last 25 years and have accounted for more than a third of our total production.

Even though the amount of corn we have produced in recent years has been fluctuating around the three-billion bushel level, the problem of surpluses is not as serious as it is with wheat. However, violent fluctuations in net exports of both commodities cause fluctuations in stocks. These, combined with the relatively even amount used domestically cause prices to change in our home market. Production always responds slowly to these changes. These fluctuations in exports are bad for our economy if we come to depend upon them as a steady and reliable outlet for our surpluses. Stocks create problems when they become large and depress market prices.

The war-torn nations of the world temporarily bailed us out of our surplus problem. But as European nations get back on their feet our exports of grain will be greatly reduced. This will mean rapid additions to stocks in the years ahead, particularly if our present levels of grain production are maintained. The best answer to this grain disposal problem lies in an expanded domestic livestock program.

This program will absorb more of our grain production domestically and reduce our dependency upon foreign outlets.

METHODS OF SUPPORT

In selecting a way to support livestock prices it will be necessary to establish equitable price relationships between livestock and livestock products as well as between livestock and grains. These will be necessary to maintain the incentives for greater livestock production. The program must also be associated with positive efforts to maintain full employment and to stabilize the levels of national income. A program for agriculture alone cannot work satisfactorily.

There are several alternatives to the method of supporting livestock prices. One would involve government purchase operations in established markets to bolster demand. The product could be disposed of through foreign or domestic relief programs. However, the present government holdings of dried eggs and powdered milk indicate some of the problems associated with this approach.

A second method would involve direct income payments to producers when market prices did not provide sufficient incentive to expand livestock production. This would be difficult to administer and might prove unpopular with producers.

The best method is a subsidized food consumption program. The first step involves expansion of the school lunch program. Another step in a food consumption program could be taken by setting up a food allotment plan. Nutritionists could determine that on a given date, a minimum adequate diet could contain a certain amount of livestock products. These might cost $4 and represent 10 percent of an average weekly income. The government could then allow any family to buy $4 worth of livestock product stamps for 10 percent of the family income. Obviously, anyone earning more than $40 a week would not find it advantageous to buy the stamps.

The advantages of a food consumption program are twofold:

1. It would move the products directly into consumption channels. No surpluses would pile up.

2. The health and usefulness of the low-income people as citizens would be greatly improved.

In keeping the prices of grains, such as corn and wheat, in line it might be necessary to set up a "Stocks Supervisory Board" that

would be required to maintain stocks at a minimum level. For example, let's say a combined total of 600 million bushels of corn and wheat. It would be the duty of the Board then to buy wheat and sell corn or vice versa to keep the prices of both products in line. It would be necessary to provide positive legal limits to the size of these stocks so as to prevent them from being built up and kept at levels so high as to interfere with the objectives of the livestock program.

Agricultural programs in the years ahead must be adaptable to the changing conditions of the American economy. Programs must take account of changes in production, consumption, and export. A support program for livestock is sound in principle since the dangers of future grain surpluses are great. In the years ahead, let's let the cow, the sow, the ewe, and the hen be our "ever-normal" granary. In this way the farmer can make a major contribution to the well-being of the American people.

YIELD AND QUALITY OF ASPARAGUS HARVESTED BY THE FIELD SNAPPING METHOD

By ROBERT L. CAROLUS
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THE DESIRABILITY of harvesting asparagus by snapping was suggested by Barrons in 1945 (1). He observed that harvesting by snapping in 1944 did not reduce the yield in 1945 and that this method of harvesting reduced the labor requirement by about 50 percent. It was also found that the labor cost of processing snapped asparagus was 55 percent less than that of processing cut asparagus. At the present time 25-35 percent of the Michigan asparagus grown for canning is harvested in this manner. Processors have been paying from 1.8 to 2.0 times as much for snapped as for cut spears. Where harvesting crews have been instructed and properly supervised in snapping, the product has been satisfactory and free of excessive fiber.

Reports from other states where green asparagus is grown, indicate that the practice is gaining in favor in many other areas. It has been suggested that temperature might influence the "break point" and that at high temperatures no definite break would occur between the very low and very high fiber regions of the stems. Studies in New Jersey (3), however, have shown that air temperatures do not affect the breaking point. In the same paper it was reported that to obtain a definite break at the junction of the high-low fiber region the spears should be at least 6 inches in height. Many growers have observed bleeding from the stumps when snapping is practiced and have questioned whether this loss of water and nutrients was not detrimental to the plant. In the New Jersey report, tests indicated that the loss of sap from the above-ground stumps was no higher than that from the underground cut stumps when the moisture in the additional length of the above-ground stump was considered.

In snapping, growers have reported that there is less tendency to snap above or below the normal "break point" when the spear is

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pushed away from the worker. When the spear is pulled toward the harvester, frequently it will snap so far down that a large fibrous portion is included. The fact that spears that are less than 6 inches in height do not snap satisfactorily at the "break point" encourages the field worker to allow them to stand an extra day in the bed. Under conditions of high temperatures, in excess of 75° F., this has resulted in a spear that may have increased in length by as much as 4 to 6 inches and one that in many instances has opened at the tip. Open tips in asparagus lower its quality and consequently result in its being off-graded by the canner. However, in Michigan where temperatures during the harvesting period generally average below 65° F. this problem is seldom encountered, as the rate of growth at temperatures less than 60° F. is seldom over 2 inches a day.

Ingenious equipment is being designed for use in harvesting asparagus by the snapping method. In one instance a series of from 5 to 9 low sleds fastened to a boom and attached to a tractor allow the workers to harvest the crop from a sitting position while they are being pulled down the middle of the row. Such a harvesting procedure would not be feasible if the workers were encumbered by cutting knives. Cutting from a sitting position would also be very hazardous to unemerged spears.

INFLUENCE OF THE SNAPPING METHOD ON YIELD

With the assistance of Mr. Donald Carpp and the Lawrence Packing company, a series of plots was laid out on a 3-year-old planting in Van Buren County in the spring of 1944. Fifteen plots, each one-hundredth acre in size, were used in comparing the productivity of the crop during a 4-year period in which snapping, above-ground cutting, and conventional below-ground cutting methods of harvesting were employed. During the first season it was found that it was impracticable to attempt to cut at the break point, so this series of plots was also snapped in subsequent years.

The results obtained in terms of pounds to the acre of edible asparagus during a 4-year period are shown in Table 1. The average percentage recovery of edible product reported by two local plants, 53.5 percent, was used in calculating the cannable portion of cut asparagus. The data were analyzed statistically by the analysis of variance method. In no year did either of the snapped treatments (No. 1 and 3) give a significantly lower yield of edible product than

TABLE 1—*Effect of harvesting method on yield of edible asparagus (Each value is the average of five plots)*

Method	1944	1945	1946	1947	Four-year average	Percent increase over cut
			in pounds to the acre			
1. Snapped	670	1,088	2,205	1,570	1,383	+15.2
2. Cut*	545	1,010	1,900	1,348	1,201	.....
3. Snapped**	502	927	1,780	1,580	1,197	−0.3
Average	572	1,008	1,962	1,499	1,260	.....
Relative S/C	117	99.8	105	117	110	.....

*Estimated 53.5% edible, based on factory averages.
**Edible portion cut above ground in 1944, snapped from 1945 through 1947.

Pounds required for significance:	5%	1%
Averages of 5	130	175
Averages of 20	65	88

that produced on plots harvested by cutting (No. 2). The yields varied significantly from year to year, owing to the fact that the planting was quite young in 1944, and as it matured the yields became larger. The decline in yield in 1947 was the result of unseasonably late frosts that year, which shortened the harvesting season.

The favorable influence of the snapping method of harvesting on yield is indicated by the fact that in the last two seasons, 1946 and 1947, the snapped plots (No. 1) produced 15.8 and 16.5 percent more edible product than the cut plots (No. 2). These differences are highly significant. In 1947, treatment No. 3 also produced highly significantly better than the cut plot.

It would appear from this data that the snapping practice is not detrimental to the planting but in time is significantly and practically beneficial. In snapping, the cut stumps are left in the field. In this experiment they amounted to from one-half to one ton per acre, which would be equivalent to from one-fourth to one-half a ton of a good legume green manure crop. In fields yielding several tons of snapped asparagus to the acre, about 3,500 pounds of stumps would remain. Analyses (2) indicate that this volume of material would contain 35 pounds of nitrogen and probably about 50 pounds of potash. Thus the organic matter itself and the nutrients it contained could help account for the improvement in yield on the plots on which snapping was practiced. Another reason for the increased relative production from snapped plots as contrasted to cut areas may be the fact that in snapping, unemerged spears are not subject to injury. All too fre-

quently when cutting is done by inexperienced labor, many unemerged spears are damaged or destroyed.

INFLUENCE OF SNAPPING ON THE PERCENTAGE OF EDIBLE PRODUCT

Many growers have felt that there is some loss in edible asparagus when the crop is harvested by snapping. It is also possible that field snapping may result in the inclusion of a portion that contains a high percentage of fiber. These possibilities were investigated in supervised harvesting studies in 1946 and 1948. Inexperienced help was instructed in the approved technique of snapping and cutting. One man was allowed to harvest 2 adjacent rows, one by snapping and the other by cutting. Five pairs of rows were harvested in 1946 and 6 in 1948. The stumps of all snapped spears were cut in the usual manner following snapping, and the cut spears were snapped in the conventional way after the asparagus had been cut.

The data in Table 2 indicate the percentage of edible product obtained by both methods of harvesting. From cut asparagus the percentage of edible product varied from 39 to 71 and from snapping the snapped portion of the total varied from 46 to 72. This rather wide variability in the edible portion is probably partly due to a difference in the snapping techniques of the individual workers. In 1946, during a rather cold period of weather resulting in slow growth, the edible product by snapping averaged 53 per cent, and by cutting,

TABLE 2—*Percentage of edible asparagus obtained by snapping and cutting procedures*

(Percentages are based on weights of entire spears)

A. 1946 Test—Harvested during cold weather, 45-55° F.

Procedure*	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Average
By cutting	39.1	49.4	62.5	55.6	49.1	.....	51.1 ± 2.6
By snapping	48.4	50.8	57.2	60.6	49.6	.....	53.2 ± 1.5

B. 1948 Test—Harvested during cool weather, 55-65°F.

By cutting	42	63	50	71	47	54	54.5 ± 3.0
By snapping	63	72	69	48	62	46	60.0 ± 3.0

*Cut asparagus was snapped after cutting. The stubs (butts) of snapped asparagus were cut after snapping. In both cases the spears were cut from one-half to one inch below the soil surface.

51 per cent. In 1948 with slightly warmer temperatures resulting in more succulent growth, the edible product by snapping averaged 60 percent, and by cutting, 54 percent.

Owing to the variability in the results obtained by the individual workers, the differences between the average, in favor of snapping, were not statistically significant. However, an increase of ten percent in yield of edible product for the snapping procedure was found in 1948. This increase in yield for snapping may be due to the difference in type of leverage exerted when rigidly anchored spears are snapped with the use of only one hand, as contrasted to the type of leverage used when both hands are used in snapping cut asparagus. Perhaps some of the increase in yield for field snapping, reported in the 4-year test above, may be accounted for in a higher actual percentage of the possible weight being obtained through field snapping than was used in the calculation of the percentage in the factory snapped yields. Field snapping may result in a break that is nearer the fibrous region than can be obtained by factory snapping.

INFLUENCE OF SNAPPING ON THE FIBER CONTENT

To determine the influence of the type of harvesting on the percentage of fiber in the waste and in the normally canned portions, samples from the 1948 field tests were analyzed for their fiber contents. One-inch cuts from both the edible portion above and the waste portion below the "break point" of both snapped and cut spears were canned separately in No. 10 cans.

After 8 months' storage the fiber content of the various lots was determined from duplicate cans of each of the four lots. One-half of the drained contents of each can was thoroughly mixed and then mashed with a table fork. One-hundred gram aliquots were transferred to a Waring blender and violently agitated with 200 ml. of water for 5 minutes. The contents of the blenders were then washed through a 40-mesh-to-an-inch screen with about 1 liter of water, to remove all of the finer material. The stringy and fibrous material that remained was then removed from the screen, dried at 80° C. for 12 hours and weighed. The fiber contents expressed as percentages of the drained net weights of the various lots, as determined by this relatively simple comparative method, are found in Table 3.

TABLE 3—*Fiber content of the break region of cut and snapped asparagus (Percentage of the drained wet weight of the canned product)*

Portion analyzed, one inch	Interval between draining and blending (hours)	Blending time (minutes)	Sample 1	Sample 2	Average
A. Field snapped					
1. Below break	0	5	.805	.815	.810
2. Above break	0	5	.012	.009	.010
3. Below break	18	5	.841	1.004	.922
4. Above break	18	5	.018	.020	.019
5. Above break	0	1	.061	.049	.055
B. Field cut					
1a. Below break	0	5	.575	.657	.616
2a. Above break	0	5	.004	.002	.003
3a. Below break	18	5	.701	.834	.767
4a. Above break	18	5	.016	.012	.014
5a. Above break	0	1	.030	.036	.030

The effect of the time interval between draining and blending and the influence of the blending time on the fiber contents is also included. In the field-snapped asparagus one-inch portions immediately below the break contained 0.81 percent fiber and those for the first inch above the break, 0.01 percent fiber. In post-harvest snapped asparagus one-inch portions below the break contained 0.616 percent fiber and those above the break 0.003 percent fiber.

These fiber percentages indicate that in field snapping more fiber is included in the cannable portion than in a factory-snapped product. However, in the snapped spears the one-inch portions just below the "break point" contained about 80 times as much fiber as the one-inch portions above the break. Noticeable fiber development in U. S. Grade A asparagus may not be present in more than 10 percent by count of the units (4). If the piece cannot be cut cleanly with a common table fork it is classified as having noticeable fiber development. Fifty pieces from each of the 4 lots were treated in this manner. All pieces from above the "break point" of either the snapped or cut spears were free from fiber on the basis of this test.

From these tests it would appear that asparagus that was either field-snapped or factory snapped, satisfactorily met the requirement for U. S. Grade A or U. S. Fancy on the basis of the fiber content. Field snapping, because it may result in as much as 10 percent more edible product than obtained by factory snapping, is not only satisfactory

from the viewpoint of a quality product but is also of economic benefit to the grower.

A study of the influence of the time interval between draining and blending and of blending time on the amount of fiber obtained (Table 3) indicates the necessity for using identical procedures with each lot for obtaining comparable results. Perhaps a shorter blending time which would result in a larger fiber residue would be entirely satisfactory.

DISCUSSION AND CONCLUSIONS

The practice of harvesting asparagus by snapping is economically sound from both the growers' and canners' viewpoints. When properly harvested, the snapped product is relatively free of objectionable fiber and capable of being harvested by the grower and handled by the canner at a 50-percent reduction in labor cost. In addition, the yielding ability of the planting is not impaired, but from the results obtained in the tests reported here, may be increased by from 10 to 15 percent. The increased productivity of the crop from snapping may be due either to better growth resulting from the practice or to a greater recovery of edible product, or to both of the above factors.

From the data given above it would seem that the practice should be unconditionally recommended to all growers and all canners. However, properly snapped asparagus containing only a very minimum of fiber requires constant supervision and inspection by both grower and canner. Only growers who are willing to instruct their harvesting labor adequately on the technique of snapping and to see that their instructions are followed should harvest the crop by this procedure.

To obtain an acceptable product the spear must be broken with the pressure applied by the thumb and fingers at a point not far below the top. If the spear is grasped too low down, the break may occur from one-half to more than one inch below the point where the fiber development occurs. Only 10 percent of the units in a can, as a maximum, may have a noticeable fiber development for a minimum grade A product. In canning, a spear is cut into three or four pieces. Therefore, if 30 percent of the spears are broken too low down, a grade A product becomes impossible. A product containing more than three to five tough pieces per can, although graded A on the basis of U. S. Standards, is so heavily discounted on the market today that the time will soon arrive when it cannot be profitably canned.

Only canners who are willing to make periodic checks on their growers to determine whether the product is free of excessive fiber should buy snapped asparagus. Snapped asparagus is more succulent, has a higher rate of respiration, and loses weight more rapidly than cut asparagus. Also, in a short time the cut ends dry and fiber development occurs in snapped spears. This makes it necessary that snapped asparagus be moved promptly from field to can. Snapped asparagus should be protected by damp bags when it is being moved from field to factory and never exposed to drying winds. To insure a quality product, snapped spears should be canned within 8 hours of harvest.

CAUTION

Asparagus is, comparatively speaking, a luxury item. Quality is imperative in maintaining consumer acceptance of this type of food product. The canner cannot maintain a demand for low-grade asparagus at a profitable price. A low-grade product marketed by one canner helps to reduce the demand for all asparagus. Canners would be well advised to reach an agreement for maintaining high uniform standards for snapped asparagus.

As the canner is the grower's market for the product, in the end, it is up to the individual grower to be sure that his product is up to a high standard and that all growers cooperate in this respect to insure a continued demand for the product. The snapping procedure of harvesting asparagus, although sound economically, can be advised only if both growers and canners are willing to cooperate in insuring a high-quality product.

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FORECAST OF FUTURE PUBLIC SCHOOL ENROLLMENTS, BY GRADES, IN MICHIGAN

By J. F. THADEN
SECTION OF SOCIOLOGY AND ANTHROPOLY

THE ENROLLMENT in the public schools of Michigan can be expected to rise annually, and by substantial additions, for another 8 years. An enrollment of 1,210,000 can be expected in 1955-56. If this prediction proves correct, there will be 212,000 more pupils than were enrolled in the public schools of Michigan last year.

Increasingly large enrollments have been experienced annually since 1944. The rising tide of school enrollees during the past four years is attributed largely to the increased number of births during the immediate pre-war years. In fact, with a few exceptions, births have been increasing annually since the depth of the depression in 1933. The peak year was reached in 1947; a total of 160,275 were born that year. These children will be largely responsible for an all-time record enrollment in kindergarten in 1952-53. During the twelve years following this date, that group will be advancing to successive peak enrollments throughout the various grades to a record-breaking high school graduating class in 1965.

The rising tide of school enrollments is creating needs for additional school buildings, school equipment, and teachers. These increased enrollments also point to the desirability of studying our hundred-year-old school district organizational set-up with a view of reducing educational inequalities.

BASIS OF FORECAST

In Michigan, the ratio of the number of children enrolled in kindergarten to those born five years earlier provides a means of forecasting enrollment in kindergarten from vital statistics data. Likewise, the ratio of the number enrolled in the first grade in a given year to those enrolled in kindergarten the preceding year can be used as a basis

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of forecasting enrollment in the first grade. It is the relatively constant ratio between the number of children in a given grade to the enrollment in the next grade the following year that serves as the basis for the forecasts presented in this article. The ratios are not necessarily the same from grade to grade.

Table 1 shows the enrollment for each grade in the public schools of Michigan for the year 1946-47 and for the year 1947-48 and also the percentage that the enrollment in each grade in 1947-48 was of the enrollment in the preceding grade the previous year. For example, the enrollment of 75,499 in the fifth grade in 1947-48 is 97.59 percent of the enrollment of 77,363 in the fourth grade the previous year. If this percentage is fairly constant from year to year—or if a rather definite trend of percentage increase or decrease is indicated over a period of years—it may be used with some feeling of confidence as a basis of making school enrollment estimates in the fifth grade for a period of years in the future.

TABLE 1—*Enrollment by grades in the public schools of Michigan in 1946-47 and in 1947-48*

	1946-47	1947-48	Percent that 1947-48 enrollment is of preceding grade in 1946-47
K	92,043	105,082	.....
1	93,544	99,033	107.59
2	84,159	85,907	91.84
3	82,749	82,321	97.82
4	77,363	80,982	97.87
5	73,895	75,499	97.59
6	71,554	72,624	98.28
7	68,735	71,033	99.27
8	65,284	65,655	95.53
9	64,079	63,580	97.39
10	59,292	56,974	88.91
11	51,769	50,662	85.44
12	45,882	46,637	90.09
Other	42,011	42,099	91.75

It will be noted that in all but one instance the enrollment in each grade was less in 1947-48 than that in the preceding grade the previous year. The carry-over to the next grade seems to be lowest, 85.44 percent, from the tenth to the eleventh grade, and highest, 99.27 percent—excluding kindergarten to the first grade—from the sixth to the seventh grade. Some children enroll in the first grade without a prior enrollment in kindergarten. This fact explains the relatively high per-

centage relationship, 107.59, between the first grade and kindergarten. As a rule, the pupils who are classed as "other" pursued post-graduate courses in the larger school systems, and any forecast as to their numbers during the coming years is subject to a relatively wide margin of error.

ENROLLMENT IN KINDERGARTEN TO BIRTHS FIVE YEARS PREVIOUS

There were enrolled in the public schools of Michigan during the school year 1947-48 a total of 105,082 children. This figure is 84.7 percent of the number of babies born about 5½ years earlier, or in 1942, when the number of births totaled 124,068. These figures and corresponding data for nine previous years are presented in Table 2. Estimates of future enrollments in kindergarten, based on number of births and estimated births, are also presented in this table.

The ratio of enrollments in kindergarten from 1938-39 to 1947-48 to births 5½ years previously rose somewhat irregularly during the preceding 10 years. The average percent during the latter half of the decade was 85.3 as compared with 83.0 during the first half of the decade. For purpose of forecasting future enrollments it is assumed that for a period of 6 years enrollments in the kindergarten of the public schools will be essentially constant at 85.0 percent of the number of births 5½ years prior, and essentially constant at 86.0 percent after that. For example, 85.0 percent of 125,441 births that occurred in Michigan in 1943 should result in an estimated enrollment in kindergarten of 106,630 in 1948-49. And 86.0 percent of an estimated number of 137,000 births in 1949 should produce an approximate enrollment of 117,820 in kindergarten in 1954-55.

The estimated enrollments in kindergarten for the next 5 years, as presented in Table 2, may be accepted with considerable reliance as it is based on official reports of recorded births. The estimated enrollments in kindergarten for 1954-55 and for subsequent years may be subject to considerable error because they are based on estimated births for 1949 through 1953.

It is reasonable to assume that births will continue to decline. This assumption is warranted, in part, on the downward trend in marriages the last two years. The United States Public Health Service reports, that for the nation as a whole, the decline in marriages in 1948 from 1946, "the only year in which there were more than two million mar-

TABLE 2—*Number of births in Michigan 1933-1942 compared to enrollments in kindergarten of public schools five and one-half years later; and number of births 1943-1948 and estimated births 1949-1953 in relation to forecasts of future enrollments in kindergarten*

Year	Number of births*	Enrollment in kindergarten†	Percent kindergarten enrollment is of births
1933	80,482	66,271 (1938-39)	82.3
1934	83,994	69,811 (1939-40)	83.1
1935	87,403	72,427 (1940-41)	82.9
1936	88,457	74,035 (1941-42)	83.7
1937	91,566	76,011 (1942-43)	83.0
1938	96,962	81,915 (1943-44)	84.5
1939	94,432	80,960 (1944-45)	85.7
1940	99,106	85,511 (1945-46)	86.3
1941	107,498	92,043 (1946-47)	85.6
1942	124,068	105,082 (1947-48)	84.7
1943	125,441	106,630# (1948-49)	85.0#
1944	113,586	96,890# (1949-50)	85.0#
1945	111,557	95,490# (1950-51)	85.0#
1946	138,572	119,030# (1951-52)	85.0#
1947	160,275	136,230# (1952-53)	85.0#
1948	153,748‡	130,686# (1953-54)	85.0#
1949	137,000#	117,820# (1954-55)	86.0#
1950	120,000#	103,200# (1955-56)	86.0#
1951	102,000#	87,720# (1956-57)	86.0#
1952	95,000#	81,700# (1957-58)	86.0#
1953	90,000#	77,400# (1958-59)	86.0#

*Michigan Department of Health, Bureau of Records and Statistics.
†Michigan Department of Public Instruction.
‡Provisional.
#Estimates by the author.

riages was about one-fifth, or close to one-half million marriages" and that "the 1948 figure was about one-twelfth below the revised total of 1,991,878 marriages in 1947."[1] There is usually a high correlation between marriage rate and the birth rate and since continued decline in marriages seems probable one may reasonably expect further declines in the birth rate. The forecasts of enrollment in kindergarten in 1954-55 and subsequent years need revisions, as official reports of births reveal the arrival of either more or fewer babies than the number predicted in Table 2. Any revisions of forecasts as to future enrollments in kindergarten may require some adjustment upwards or downwards of forecasted enrollments in the grades in subsequent years.

ASSUMPTIONS UNDERLYING ESTIMATED ENROLLMENTS IN GRADES

A study of the enrollment in a given grade in comparison with the enrollment in the preceding grade the previous year, and the constancy, variability and trend of this relationship over a period of years

[1]U. S. Public Health Service, advance release, April 4, 1949.

may serve as a basis of projecting future estimated enrollments. Table 3 contains the figures on which past tendencies and trends may reflect future enrollments by grades.

TABLE 3—*Percent that enrollment in each grade in the public schools of Michigan was of the enrollment in the preceding grade the previous year: 1937-38 to 1947-48*

Grades	1937–38 to 1938–39	1938–39 to 1939–40	1939–40 to 1940–41	1940–41 to 1941–42	1941–42 to 1942–43	1942–43 to 1943–44	1943–44 to 1944–45	1944–45 to 1945–46	1945–46 to 1946–47	1946–47 to 1947–48	10-year average
K to 1st.....	119.42	117.64	114.09	114.32	114.40	116.20	113.51	112.95	109.39	107.59	113.95
1st to 2nd....	91.44	92.53	93.02	93.12	93.32	93.42	91.94	91.16	92.04	91.84	92.38
2nd to 3rd....	97.59	98.16	98.25	98.37	98.02	98.92	98.20	97.36	97.63	97.82	98.03
3rd to 4th	98.69	98.59	99.19	99.27	98.97	99.55	98.14	97.11	97.87	97.87	98.59
4th to 5th....	98.53	99.07	99.06	98.91	98.39	99.87	97.84	97.08	97.64	97.59	94.40
5th to 6th....	98.13	98.63	98.62	98.18	103.16	99.66	97.67	97.39	98.25	98.28	98.80
6th to 7th....	99.54	99.46	99.88	99.56	99.05	95.19	98.85	99.50	99.64	99.27	98.99
7th to 8th....	97.34	97.44	97.00	96.07	94.32	96.75	95.42	94.99	95.27	95.53	96.01
8th to 9th....	95.82	96.00	95.48	93.95	93.36	93.53	94.72	95.06	95.50	97.39	95.08
9th to 10th...	91.70	91.03	89.22	86.94	84.10	83.76	87.69	88.83	89.27	88.91	88.14
10th to 11th..	87.78	87.65	84.59	82.41	76.09	80.06	82.32	85.00	85.40	85.44	83.67
11th to 12th..	94.32	92.35	88.47	86.52	82.09	81.80	84.06	88.79	92.13	90.09	88.06
12th to other .	74.80	84.36	72.11	147.31	65.93	67.90	84.18	85.28	100.66	91.75	87.43

It will be noted from Table 3 that the percentage of enrollment in the first grade averaged 113.95 percent of kindergarten enrollment during the 10 year period, 1937-38 to 1947-48. The highest percentage was 119.42 at the beginning of this decade and the lowest was 107.59 percent at the end of the decade. The drop went into reverse during three of the ten years mentioned, but the average drop was 1.18 percentage points for the whole decade. It is possible though not probable that this trend of the past 10 years will continue. It is here assumed that the enrollment in grade one to kindergarten enrollment the previous year will be increasingly less than 1.18 until 1954-55 and remain relatively constant at 98.6 after this date.

The assumptions underlying forecasts of future enrollments in the other grades are as follows: that the ratio of the enrollment in the

2nd grade to the enrollment in the 1st grade will be essentially constant, namely 92.0 percent
3rd grade to the enrollment in the 2nd grade will be essentially constant, namely 98.0 percent
4th grade to the enrollment in the 3rd grade will be essentially constant, namely 97.8 percent
5th grade to the enrollment in the 4th grade will be essentially constant, namely 97.5 percent
6th grade to the enrollment in the 5th grade will be essentially constant, namely 98.2 percent
7th grade to the enrollment in the 6th grade will be essentially constant, namely 99.3 percent
8th grade to the enrollment in the 7th grade will be essentially constant, namely 95.5 percent
9th grade to the enrollment in the 8th grade will be essentially constant, namely 97.5 percent
10th grade to the enrollment in the 9th grade will be essentially constant, namely 89.0 percent
11th grade to the enrollment in the 10th grade will be essentially constant, namely 86.0 percent
12th grade to the enrollment in the 11th grade will be essentially constant, namely 89.0 percent
Other grade to the enrollment in the 12th grade will be essentially constant, namely 90.0 percent

Obviously, the enrollment in any given grade to the enrollment in the preceding grade the previous year will not be constant, as assumed,

but may probably be as irregular during the next 11 years as it was during the past 10 years. However, the nature and extent of future probable irregularities are not apparent and it is reasonable to assume it to be constant for the purpose of forecasting future school enrollments.

The probable future enrollment in the class labeled "others" is most difficult to predict. It can be affected tremendously by legislation. For example, enactment of legislation which creates community colleges would tend to increase the enrollment in this group.

ESTIMATED FUTURE ENROLLMENT

The figures in Table 4 indicate the estimated number of pupils who may be expected to be enrolled in the public schools of Michigan, by grades, during each of the next 11 years. Expected percentage changes since last year are also presented. The forecasts are based on the formulae or assumptions which have been discussed on the preceding pages.

It will be noted that the enrollment in kindergarten is expected to reach a peak figure of 136,230 in 1952-53, or 29.6 percent higher than last year's enrollment. Enrollment in the first grade, if these estimates are correct, will reach 137,220 in 1953-54, which is 38.6 percent higher than was the enrollment in the first grade last year. This super-size first-grade enrollment will create a 12-year bulge in school enrollment and when its pupils reach the sixth grade in 1958-59, the enrollment in the sixth grade may be 59.5 percent larger than last year's sixth grade class.

The peak enrollment in the elementary grades is expected about 1954-55, with a total of 924,000 pupils, which will be 25.3 percent more than last year's enrollment. It is estimated that there will be 186,000 more pupils enrolled in the public elementary schools in 1954-55 than in 1947-48, which is the equivalent of 6,200 additional classrooms of 30 pupils each.

The peak enrollment in grades 9, 10, 11, and 12 during the next decade may be expected in 1958-59, when an estimated enrollment of 276,000 will be 26.8 percent larger than the enrollment of 217,853 last year.

These forecasts can be affected by many factors, especially by a radical change in the prevailing population growth within the state. Since 1940, the natural increase of population in the state has been

TABLE 4—*Forecast of future enrollment by grades in the public schools of Michigan*

Grade	1947–48	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
K	105,082	106,630	96,890	95,490	119,030	136,230	130,690	117,820	103,200	87,720	81,700	77,400
1	99,033	111,830	112,230	100,870	98,330	121,220	137,220	130,180	116,170	101,760	86,030	80,560
2	85,907	91,110	102,880	103,250	92,800	90,460	111,530	126,240	119,760	106,880	93,620	79,150
3	82,321	84,190	89,290	100,820	101,190	90,950	88,650	109,300	123,710	117,370	104,740	91,740
4	80,983	80,510	82,340	87,320	98,610	98,960	88,940	86,700	106,890	120,990	114,790	102,440
5	75,499	78,960	78,500	80,280	85,140	96,140	96,490	86,720	84,540	104,220	117,970	111,920
6	72,624	74,140	77,540	77,080	78,830	83,610	94,410	94,750	85,160	83,010	102,340	115,840
7	71,033	72,120	73,620	76,990	76,540	78,280	83,020	93,750	94,090	84,560	82,430	101,630
8	65,665	67,840	68,870	70,310	73,530	73,100	74,760	79,290	89,530	89,860	80,760	78,720
K-8	738,147	767,330	782,160	792,410	824,000	868,950	905,710	924,750	923,050	986,370	864,380	839,400
9	63,580	64,020	66,140	67,150	68,550	71,690	71,270	72,890	77,310	87,290	87,610	78,740
10	56,974	56,590	56,980	58,870	59,760	61,010	63,810	63,430	64,870	68,800	77,690	77,970
11	50,662	49,000	48,660	49,000	50,620	51,400	52,470	54,870	54,550	55,790	59,170	66,810
12	46,637	45,090	43,610	43,310	43,610	45,060	45,740	46,700	48,840	48,550	49,650	52,660
9-12	217,853	214,700	215,390	218,330	222,540	229,160	233,290	237,890	245,570	260,430	274,120	276,180
Other	42,099	41,970	40,580	39,250	38,980	39,250	40,550	41,170	42,030	43,950	43,700	44,690
Total	998,099	1,024,000	1,038,130	1,049,990	1,085,520	1,137,360	1,179,550	1,203,810	1,210,650	1,200,750	1,182,200	1,160,270
Percent change since 1947–48												
K	100.0	1.5	−7.8	−9.1	13.3	29.6	24.4	12.1	−1.8	−16.5	−22.7	−27.3
1	100.0	12.9	13.3	1.9	−0.7	22.4	38.6	31.5	17.3	2.8	13.1	18.7
2	100.0	6.1	19.8	20.2	8.0	5.3	29.8	46.9	39.4	24.4	9.0	−7.9
3	100.0	2.3	8.5	22.5	22.9	10.5	7.7	32.8	50.3	42.6	27.2	11.4
4	100.0	−0.6	1.7	7.8	21.8	22.2	9.8	7.1	32.0	49.4	41.7	26.5
5	100.0	4.6	4.0	6.3	12.8	27.3	27.8	14.9	12.0	38.0	56.3	48.2
6	100.0	2.1	6.8	6.1	8.5	15.1	30.0	30.5	17.3	14.3	40.9	59.5
7	100.0	1.5	3.6	8.4	7.8	10.2	16.9	32.0	32.5	19.0	16.0	43.1
8	100.0	3.3	4.9	7.1	12.0	11.3	13.9	20.7	36.3	36.8	23.0	19.9
K-8	100.0	4.0	6.0	7.3	11.6	17.7	22.7	25.3	25.0	21.4	17.1	13.7
9	100.0	0.7	4.0	5.6	7.8	12.8	12.1	14.6	21.6	37.3	37.8	23.8
10	100.0	−0.7	0	−3.3	4.9	7.1	12.0	11.3	13.9	20.8	36.4	36.9
11	100.0	−3.3	−4.0	−3.3	−0.1	1.5	3.6	8.3	7.7	10.1	16.8	31.9
12	100.0	−3.3	−6.5	−7.1	−6.5	−3.4	−1.9	0.1	4.7	4.1	6.5	12.9
9-12	100.0	−1.4	−1.1	−0.2	2.2	5.2	7.1	9.2	12.7	19.5	25.8	26.8
Other	100.0	−0.3	−3.6	−6.8	−7.4	−6.8	−3.7	−2.2	−0.2	4.4	3.8	6.2
Total	100.0	2.6	4.0	5.2	8.8	14.0	18.2	20.6	21.3	20.3	18.4	16.2

supplemented by substantial additions through migration from other states. It is estimated that the population of Michigan was 6,069,000 as of July 1, 1947, an increase of 812,894, or 15.5 percent over the population figure of 5,256,106 on April 1, 1940. Of this total increase in population, it is estimated that natural increase (excess of births over deaths) totaled 482,749, and that net migration to Michigan totaled 330,145. Thus natural increase contributed 59 percent to the growth of population of Michigan since 1940 and migration from other states and countries contributed 41 percent.[2] A severe economic recession may slacken the flow of migrants to Michigan and, consequently, affect these forecasts of school enrollments somewhat.

However, these population forecasts are likely to be affected more by changes within the state, than by changes in inter-state migration. This can be illustrated by a change in the school code several years ago and its apparent affect on secondary school enrollments the following year. A law which makes school attendance compulsory until the age of 16 years was enacted by the Michigan legislature in 1947 which materially affected a forecast of school enrollment in high school, especially in the tenth grade.

Table 5 presents the enrollment in the public schools of Michigan for the year 1947-48, by grades and also a forecast of expected enrollments, which was made about a year before the actual enrollments in

TABLE 5—*Forecast of school enrollment compared with actual enrollment: 1947-48*

Grade	Actual Enrollment	Estimated Enrollment*	Percent Difference
K	105,082	105,457	0.4
1	99,033	101,246	2.2
2	85,907	86,060	0.2
3	82,321	82,164	−0.2
4	80,983	80,977	.0
5	75,499	75,536	.0
6	72,624	72,602	.0
7	71,033	71,296	0.4
8	65,663	65,482	−0.3
K-8	738,147	740,820	0.4
9	63,580	62,346	−1.9
10	56,974	52,930	−7.1
11	50,662	50,635	0
12	46,637	47,695	2.3
9-12	217,853	213,606	−2.0
Others	42,099	38,000	−9.7
Total	998,099	992,430	0.6

*J. F. Thaden, "Effect of the Increased Birth Rate on School Enrollment and School Building Needs." Mich. Agri. Exp. Sta. Quart. 31 (Aug. 1948): 1-11.

[2]J. F. Thaden, "Population Changes in the Rural and Urban Areas of Michigan Since 1940." Mich. Agr. Exp. Sta. Quart. Bul., *31* (Nov. 1948): 233-249.

1947-48 became available. It will be noted that the forecasted enrollments differ from the actual enrollment by less than 1 percent for all grades except first, ninth, tenth, and twelfth. The forecasts made a year ago are based on formulae different from those used in the present forecast of future enrollments.

The forecasted enrollment for the tenth grade was underestimated by about 4,000 pupils, or 7.1 percent. Forthcoming legislation that will affect future school enrollments can not always be foreseen, or if so, the year that such legislation will be enacted.

SOME IMPLICATIONS

In general, the public seems unaware that school enrollments in most grades and during most years throughout the 1950's will inevitably be much greater than during the 1940's. Already thousands of students in elementary schools are attending half-day sessions and frequently in buildings that are ill-adapted for classrooms. Almost daily, news items inform us that propositions for additional school buildings are voted down. At present, many elementary schools are overcrowded and understaffed. Classes of more than 50 pupils are quite prevalent in rural as well as in urban areas of the state. More than 12,000 elementary-school children, not including those in kindergarten, are in school only part time because there are not enough classrooms for them to attend school full-time. These conditions will get increasingly worse for at least seven or eight more years unless real efforts are made to meet the increasing needs.

Creation of community school districts with flexible school attendance areas are possibilities as means of solving some perplexing present-day educational problems on a long-term basis. Administrative and school taxing units which are organized on the basis of natural, sociological communities have inherent potentialities for meeting emergencies, such as the present and immediate future school building and teacher crises; more so than more ancient, smaller, and relatively inflexible school organizational units. There is a need, a much greater need than existed heretofore, of citizens within their respective communities making thorough studies of their school district organization and formulating plans to meet inevitable educational needs of the immediate future.

THE AGRICULTURAL EXPERIMENT STATION, SEED CERTIFICATION, AND THE MICHIGAN FOUNDATION-SEED ASSOCIATION, INC.

By R. E. DECKER
SECTION OF FARM CROPS

THE FUNCTION of the Michigan Crop Improvement Association as a certifying agency for crop varieties, recommended for certification by the plant breeders in the Farm Crops Department, has become quite well established in the minds of Michigan farmers during the past three decades.

Recently there has been organized the Michigan Foundation-Seed Association, Inc. What position does it occupy in relation to the Michigan Crop Improvement Association and to the Michigan Experiment Station?

In answering this question the work of all agencies will be explained so that their relationship, one to the other, will be better understood.

PLANT BREEDING AS APPLIED TO FIELD CROPS

Before the late Prof. Frank Spragg joined the staff of the Michigan Agricultural Experiment Station in 1906 practically no work had been done at this station in the improvement of field crops through plant breeding methods. From that time, however, the development and testing of new varieties has been one of the important activities in the experimental work of the Farm Crops Department.

Professor Spragg worked with all field crops. His early work was with oats and he introduced varieties named Alexander, College Success, and College Wonder.

As new varieties were developed small amounts were sent out to farmers in different parts of the state to grow in the same field with the variety they had been growing. One of the requirements in obtaining some of the new seed was that the grower report on how the new variety had performed.

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It was not long until men interested in this work formed an organization known as the Michigan Experiment Association.

But testing and reporting of results of tests was not accomplishing all that was desired. Pure seed of the new varieties was not being produced in any quantity and, therefore, the majority of farmers were not benefited by the work that the plant breeders had done.

The plant breeders at the Experiment Station were doing their work, a few farmers were growing some of the improved varieties, many more farmers wanted seed, but there was no quantity of pure seed being produced for them.

Such was the situation in 1917 when the members of the Michigan Experiment Association and members of the Experiment Station staff decided that a different type of organization should be formed.

THE MICHIGAN CROP IMPROVEMENT ASSOCIATION

The new organization was named the Michigan Crop Improvement Association. It was incorporated under the non-profit laws of Michigan.

Membership in the new organization was open to any farmer in the state who wished to grow seed of varieties which the plant breeders had found superior and which had been recommended for increase. The grower would sow pure seed, and have the growing grain inspected just before harvest by inspectors trained by members of the Farm Crops Department staff. After threshing he would submit a bin sample of the grain for purity and germination tests. If his crop passed both the field and bin sample inspections it was certified as to varietal purity.

Michigan was one of the first states to organize a Crop Improvement Association. Today there are approximately 35 states with similar organizations. In most of these states the certifying organization works very closely with the agricultural experiment station and the extension service. Seed improvement work is one of the projects approved by the federal extension service. Pure seed of adapted varieties is essential if maximum yields and top quality are to be obtained from the crops we grow.

In many states, including Michigan, the secretary of the crop improvement association is an extension specialist on the college staff.

The way the association was organized in this state, the head of the Farm Crops Department and one of the plant breeders, represent the Agricultural Experiment Station on the association's Board of Directors.

Who determines when a variety is worthy of inspection and certification? In Michigan the plant breeders, who have tested a variety for at least 3 years in different sections of the state, decide whether the performance of the variety merits its being introduced for inspection and certification. Yield, quality, resistance to disease, commercial preference, are some of the factors considered in arriving at a decision.

Varieties considered are not limited to those developed by Michigan's own plant breeders. Each year new varieties of various crops are obtained from other states and tested at East Lansing and in the over-state trials. Wisconsin No. 38 barley, Yorkwin wheat, several corn hybrids, soybean varieties and most of the potato varieties now certified in Michigan were developed by other experiment stations. On the other hand, Spartan barley developed in Michigan is still popular in some midwestern states. Michelite beans are widely grown in New York state.

Briefly, the Michigan Crop Improvement Association is an organization of Michigan farmers who are interested in producing pure seed of those field crop varieties which possess outstanding characteristics. The plant breeders of the Agricultural Experiment Station decide whether a variety is worthy of inspection and certification by the Crop Improvement Association.

THE MICHIGAN FOUNDATION-SEED ASSOCIATION, INC.

As the interest in production of certified seed has increased there have been new problems for the Crop Improvement Association. The production of parent stock of corn hybrids requires that somebody, or some organization, take the responsibility of producing that parent stock. Whenever a new small grain has been approved for certification it is necessary that somebody grow enough seed so that a large quantity can be produced for release to certified seed growers.

The Michigan Crop Improvement Association assumed the responsibility of having parent stock of corn hybrids produced. The organization also located growers to make initial increases of seed of small-grain varieties.

In order to relieve the Crop Improvement Association of these assumed responsibilities the Michigan Foundation-Seed Association has been formed. This organization has been incorporated under the non-profit laws of Michigan.

The purposes of this new organization as set forth in its by-laws are:

> . . . to promote, encourage, foster, facilitate and assist in the development of the Agricultural industry in the state of Michigan in cooperation with the United States Department of Agriculture, Michigan State Department of Agriculture, Michigan State College, Michigan Crop Improvement Association, and any other governmental agency, and any parties or associations interested in promotion of the objects for which this corporation is formed through the selection, breeding, propagation, production and distribution of improved strains and varieties of agricultural and horticultural seeds and stocks for vegetative propagation, and to promote and foster in cooperation with the Michigan State College educational and research activities and programs in connection therewith; to make available to Michigan farmers improved strains and varieties of seeds and stocks for vegetative propagation and to receive and expend funds for these purposes.

Membership in this new organization shall be open, but limited, to the members of the Michigan Crop Improvement Association who have entered into and are parties to an agreement with this corporation for the production of certified seeds.

There are no members of the Agricultural Experiment Station staff on the Board of Directors of this new organization, although members of the staff may and have been asked to advise with the Directors. The Directors have employed a manager who is not on the College or Agricultural Experiment Station staff.

SUMMARY

Plant breeders on the Farm Crops staff will continue to develop and test new varieties of field crops and they will continue to test new varieties developed at other state agricultural experiment stations. After at least 3 years of trials any variety showing exceptional characteristics may be recommended for increase and certification in Michigan.

The parent stock will be released to the Michigan Foundation-Seed Association, Inc., for increase, such increase to be supplied to growers of certified seed.

The Michigan Crop Improvement Association will inspect field crops grown for certification and certify the seed from such crops if it meets the required standards.

FOUR YEARS OF SOW TESTING IN MICHIGAN

By H. F. MOXLEY and W. N. McMILLEN
SECTION OF ANIMAL HUSBANDRY

THE MICHIGAN Sow Testing Project was started in 1945 with the slogan, "More pork from fewer sows." Litters entered are ear-marked at birth. The farrowing date and record are verified within 7 days by an official witness. The pigs are weighed out at 56 days or as near that age as possible and the weights adjusted to the 56-day basis, using a conversion table. The witness may be the county agricultural agent, the vocational agriculture instructor, or someone appointed by them.

To encourage participation in the project the Michigan Swine Breeders' Association awards a medal to each contestant making certain achievements.

Medal awards are determined as follows:

1) *Litters from sows*—Gold—400 pounds or more
Silver—350 to 399 pounds
Bronze—300 to 349 pounds

2) *Litters from gilts*—Gold—350 pounds or more
Silver—300 to 349 pounds
Bronze—250 to 299 pounds

Each participant is eligible for only one medal, the one representing the highest litter weight from his herd. Sows and gilts raising litters weighing 250 pounds or more are listed in the project report each year.

RESULTS AND DISCUSSION

A summary of the data for the four years is arranged by litter weights in Table 1 and by litter size in Table 2. About 80 percent of the litters that were entered finished the project over the four years. Sixty-three percent of the sows and gilts finishing the project produced litters weighing 250 pounds or more. The data include records on

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1,198 litters and 10,114 pigs weaned. The average size litter weaned was 8.4 pigs and the average pig weight 33.2 pounds.

TABLE 1—*Comparisons of litter data arranged in grouping litter weights at 56 days: 1,198 litters — 10,114 pigs*

Weight of litter at 56 days, in pounds	Number of litters in group	Percent of litters in group	Average number pigs weaned	Average weight of pigs at 56 days, in pounds	Average litter weight in each group, in pounds
400 lbs. and over....	108	9.0	10.5	42.5	447.3
350 lbs. to 399 lbs....	142	11.9	9.7	38.2	369.5
300 lbs. to 349 lbs....	238	19.9	9.1	35.4	322.0
250 lbs. to 299 lbs....	259	21.6	8.6	32.0	274.1
200 lbs. to 249 lbs....	237	19.8	7.8	28.9	225.9
150 lbs. to 199 lbs....	139	11.6	7.0	25.5	179.1
149 lbs. or less.....	75	6.2	5.0	23.2	115.8

Pigs weaned 8.4 Average weight 33.2 pounds.

TABLE 2—*Comparison of pig and litter weights due to size of litter 1945 to 1948 inc. 1,198 litters — 10,114 pigs*

Size of litter	Litters in group	Percent of litters in group	Average weight of pigs at 56 days, in pounds	Average litter weight at 56 days, in pounds
11 or more.....	143	11.9	33.0	375.3
10.....	208	17.4	32.8	328.1
9.....	258	21.6	33.8	304.0
8.....	246	20.5	33.4	263.7
7.....	176	14.7	33.1	231.4
6 or less.....	167	13.9	32.9	175.7

Pigs weaned 8.4. Average weight 33.2 pounds.

The data show that size of litter is of major importance in achieving high litter weight. There is little difference in average pig weight due to litter size in litters up to 11 pigs. There is a wide weight range within each litter size group. The high average pig weight has fallen in a different litter size group each of the four years the project has been conducted. Only two litters of eight pigs have attained 400 pounds or more.

Results of each of the four years are very similar. Each year the 10 high sows weaned as many pigs as the 20 low ones. The litters of the 10 highest producers weighed as much at 56 days as the litters from the 30 low sows.

The entries have been almost equally divided between sows and gilts. Mature sows have weaned 0.5 to one pig per litter more each year than did the gilts. The pigs from sows averaged 2 to 4 pounds

heavier than the pigs from gilt litters. Advantage of litter size and pig weight in favor of the sows over gilts is increasing since good sows are kept and the poor producers culled.

Some idea of the repeatability is gained from the fact 28.8 percent of the litters in the 1948 project were from sows that had made records or from gilts whose dams had been tested. Of the litters weighing 400 pounds or more, 43.2 percent were from tested dams. There is a strong tendency for sows producing heavy litters to repeat. There is a great variation in the production records of gilts from tested sows, even among litter mates. One farmer had a sow that weaned a 1948 spring litter that at 56 days weighed 534 pounds and also a fall litter from the same sow that weighed 502 pounds. As a gilt the preceding year, this sow weaned a litter that weighed 484 pounds. The dam of this sow won the 1946 project with a litter that weighed 579 pounds at 56 days of age.

The principal value in increasing productivity in swine so far has been by improved management through extension contacts with project cooperators. For example, one county that had only 9 litters weighing over 250 pounds in 1945 had 46 in 1948. On several farms the weaning weights increased as the cooperators found out how to improve their feeding and management practices.

Another value lies in the increasing interest in production factors. Breeders and buyers are becoming more observing of the number of udder sections, femininity, litter size and other indications of production. There is a tendency for gilts and boars of acceptable type from production litters to outsell those from small litters or those with poor underlines.

The almost constant contact between the extension staff and the county leaders in sow testing has been a big factor in the establishment of seven county and district swine breeders associations representing 12 counties.

WHAT ALFALFA VARIETY FOR MICHIGAN?

By S. T. DEXTER
SECTION OF FARM CROPS

NEW ALFALFA varieties of some promise are continually being brought out by plant breeders in various parts of the country. As seed becomes available in sufficient amounts, these varieties are thoroughly tested in fields at the agricultural experiment stations, where they can be examined for disease and insect resistance, ease of seeding, winter hardiness, yields, etc. If the varieties seem useful, seed supplies are gradually increased, and eventually become available to farmers in general. Three such varieties, Ladak, Ranger, and Buffalo, have recently been recommended to combat bacterial wilt disease in alfalfa.

Ladak, the oldest variety, is only moderately resistant to bacterial wilt, but is winter hardy and survives reasonably well where wilt is severe. The variety has several objectionable features. First of all, it is highly variable, and seed from different regions may give fields widely different in growth behavior. In general, it is slow to start in the spring, is slow to start up after cutting, and has a short growth in the fall or late summer when the days begin to shorten. It is a little later to mature than our common Michigan Grimm and variegated, and can be cut at the end of the haying season. True Ladak tends to give but one cutting when handled in that way, and this cutting is likely to yield more than the first cuttings of ordinary alfalfa. Over a period of years it has yielded about as well each year as any other variety. Farmers have objected to the small growth during the summer and fall. It is less green than Hardigan, and flowers less profusely. For the northern part of Michigan where one cutting is common, it seems a good variety.

Ranger, a newer variety, is a Turkestan alfalfa, highly resistant to bacterial wilt, but somewhat less cold resistant or winter hardy than our best Michigan Grimm or Hardigan. Under field conditions, it

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rarely outlasts Grimm to a practical extent, since by the time the Grimm is killed by wilt, the Ranger is likely to be thinned by winter injury or diseases other than wilt to such a degree that the field is not worth leaving for hay. Under very severe conditions of wilt, it would probably be superior to Grimm. It has given yields around 90 to 95 percent as much as Grimm or Hardigan, over a testing period of about 10 years. It is a little earlier to start in the spring than our standard varieties. It tends to be yellowish, rather than bluish-green, with decidedly less bloom than Grimm. Leaf diseases cause some trouble.

Buffalo is a selection from Kansas Common strains, but possesses high resistance to bacterial wilt. It seems well adapted to regions as far north as central Ohio, Indiana and Illinois, and might be satisfactory in regions in Michigan where winter-killing is not much of a problem. It tends to start growth rather early in the spring, and at the Lake City Experiment Station, spring frosts have frequently frozen it back severely. This greatly weakens the plants and cuts down the yield of hay. In some years, the plants are decidedly yellowish, and by no means as attractive in appearance as the standard varieties.

Over a period of about 10 years, one or more of these three varieties has been tested in comparison with Grimm or Hardigan in large field plots. Brief descriptions of the experiments and tables of the yields of hay are given below.

COMPARISON OF LADAK AND HARDIGAN

To compare Ladak and Hardigan alfalfas, fields were planted in alternate strips of these varieties, both alone and in mixture with brome grass, timothy, orchard grass, and red clover. Since corresponding plots occurred with both varieties, hay yields are reported without regard to the particular mixture.

In 1936 a field was seeded at East Lansing, so that three different systems of cutting might be studied with the two varieties. Table 1 shows the three systems of cutting and the yields of hay obtained. After two years of cutting, these plots were plowed up, since a very heavy loss of stand occurred in the summer of 1938, owing to bacterial wilt in both varieties.

TABLE 1—*Yield of oven-dry hay per acre from plots of Ladak and of Hardigan in pounds per acre**

Date cut	CUTTING TREATMENTS					
	(Bud) Fl. Bl. and Nov.		(Bud) and Fl. Bl.		Fl. Bl. and Fl. Bl.	
	Lakak	Hardigan	Ladak	Hardigan	Ladak	Hardigan
Year 1937						
June 11	3327	3317	3715	3615		
July 6					4225	3995
August 13	2946	2755	2854	2829		
August 25					2505	2609
November 4	501	705				
Total 1937	6774	6777	6569	6444	6730	6604
Year 1938						
June 9	3295	3532	3198	3350		
June 30					4655	4541
July 30	1663	1571	1772	1681		
August 26					1182	1012
November 1	691	736				
Total 1938	5569	5839	4970	5031	5837	5553
Total 2 years	12343	12616	11549	11475	12567	12157

*Three systems of cutting management were practiced on field plots of Hardigan and Ladak in various mixtures with grass and clover. The oven-dry weights of hay per acre harvested on the dates shown are given in the table. Seeded in 1936, both varieties were destroyed by wilt in late summer of 1938.

The experiment was repeated on another field, with the results shown in Table 2.

TABLE 2—*Yield of oven-dry hay per acre from plots of Ladak and Hardigan in pounds per acre**

Date cut	(Bud) Fl. Bl. and Nov.		(Bud) and Fl. Bl.		Fl. Bl. and Fl. Bl.	
	Ladak	Hardigan	Ladak	Hardigan	Ladak	Hardigan
Year 1940						
June 17	4013	3974	3844	4027		
July 2					4530	4451
August 15	1910	2243	1906	2179		
September 4					1792	2094
November 4	532	800				
Total 1940	6465	7027	5750	6206	6322	6545
Year 1941						
June 11	3785	3767	4066	4098		
June 24					4389	4248
August 6	1407	1427	1415	1513		
November 3	216	299			1112	1332
Total 1941	5408	5493	5481	5601	5601	5580
Total 2 years	11873	12520	11231	11807	11823	12125

*As in Table 1, but seeded in 1939. Drowned out in winter 1941. Yields of oven-dry hay harvested per acre are shown.

It is apparent that there is little difference in the yield in these varieties. Although the Ladak was definitely less green than the Hardigan, and had fewer blossoms, it did not show the expected slow recovery in second growth, nor any appreciable superiority in wilt resistance. Its fall growth was less than in Hardigan. This Ladak was "certified" seed. Other lots of Ladak seed have shown the characteristic slow recovery in some cases, but the Ladak seed lots used have been highly variable. One is led to suspect that in many cases even certified Ladak has become mixed and is not fully true to the original characteristics of the variety. In the later years of the experiments, after this difficulty was recognized, particular effort was made to obtain true Ladak seed.

To compare the varieties farther north, a field was put in at Lake City Experiment Station in 1937. Part of the field was very heavily fertilized. The yields from early and from late cutting are shown in Table 3.

TABLE 3—*Yields of oven-dry hay at Lake City in pounds per acre (Seeded 1937)**

June 17 (bud)	Ladak	Hardigan	July 1	Ladak	Hardigan
		1938			
Ordinary fertilizer	2874	2862		3379	2916
Heavy fertilizer	3272	3207		3755	3384
		1939			
June 20					
Ordinary fertilizer	3114	2412			
Heavy fertilizer	3744	2988			

*Seeded in 1937, hay yields were taken in 1938 and 1939, after which the field was pastured. Oven-dry yields of hay for one cutting are shown. Each figure is the average yield from six plots.

After two years of cutting, the field was used as pasture, the varieties seeming about the same. Although these figures are not particularly extensive, they indicate that the Ladak variety may be superior in a region where but one cutting of alfalfa is usual. Later results (Table 7) seem to confirm this view.

COMPARISONS OF LADAK, HARDIGAN, AND RANGER

When Ranger seed became available, this variety was included in the alfalfa trials. The three varieties were seeded at East Lansing both

alone and in various proportions with timothy. In the first cutting part of each plot was cut early and part late. Table 4 shows the weights of hay taken per acre at each cutting.

TABLE 4—*Summary of the yields of dry matter of Hardigan vs. Ranger vs. Ladak in pure stands and in mixture with timothy**

Variety	Year 1942						Year 1943					
	First cutting taken early			First cutting taken late			First cutting taken early			First cutting taken late		
	1st	2nd	Total	1st	2nd	Total	1st	2nd	Total	1st	2nd	Total
Hardigan	3901	3361	7262	4452	3708	8160	3950	1306	5256	4286	1895	6181
Ranger	3721	2951	6672	4138	3237	7375	3846	1218	5064	4027	1772	5799
Ladak	4226	3521	7747	4906	3496	8402	4058	1054	5112	4147	1773	5920

*Hardigan, Ranger, and Ladak, seeded alone and in various mixtures with timothy. The yields of hay are shown under various methods of cutting management. The field was not worth leaving for hay in 1944 owing to winter-killing and drowning out. Each figure is the average of weights from 18 plots.

In Table 5, the results are summarized. Since cuttings were taken both late and early, and of mixtures with grass as well as of pure alfalfa, the figures represent as nearly as possible "alfalfa hay" as it might be planted and cut in this region.

TABLE 5—*A summary of Table 4, comparing three varieties under a wide range of conditions of cutting and in mixtures**

	1942 Grand Ave. 2 cut total	1943 Grand Ave. 2 cut total	Total yield in 2 cuts in 2 years	Yield November 1 cutting 1942	Grand total	As percent
Hardigan	7710	5719	13429	535	13964	100
Ranger	7024	5432	12456	357	12813	91.7
Ladak	8075	5660	13735	227	13962	100

*For each variety, the same mixtures, in equal numbers, with timothy were used. The cuttings were taken both early (i.e. near the start of haying season) and late (near the end of haying season). Thus, as nearly as possible, the figures represent "alfalfa hay" as it might be cut and planted in this region.

Since Ranger is a variety made up by mixing several strains, which then cross, making "hybrids", it was thought advisable to test some first-generation crosses against some later generations, in comparison with Grimm or Hardigan alfalfa. No differences were notable between the various Ranger generations. Table 6 shows the yearly yields of the Rangers as compared with Grimm alfalfa.

The seed of the new variety Buffalo became available in 1944 and was included in the plots on a field basis at both Lake City and East

TABLE 6—*Comparing Grimm alfalfa with several generations of Ranger, at East Lansing. Yield in oven-dry hay per acre*

Year	Cuttings	Grimm	Ave. of Ranger
1943	2	6274	5833
1944	2	4994	4598
1945	2	6058	5733
1946	1 weedy	2003	2325
Totals		19329	18489
		100%	94.4%

TABLE 7—*Hay yields of Ladak, Ranger and Buffalo alfalfas, in comparison. Grimm used as the standard, 100%*

Year	No. of cuttings	Variety				Remarks
		Grimm	Ladak	Ranger	Buffalo	
East Lansing						
1947	1	100	.....	84.3	68.7	Seed 1946
1948	1	100	.....	96.3	84.5	Seed 1946
1948	2	100	.....	94.4	88.0	Seed 1947
Lake City, seed 1944						
1945	1	100	125.5	98.4	72.9	All exc., no grass
1946	1	100	109.0	88.4	82.0	Good alfalfa, considerable grass
1947	1	100	77.7	82.4	67.8	Good alfalfa, considerable grass
1948	1	100	102.0	90.0	70.7	Fair alfalfa, much grass

Lansing Experiment Stations. Table 7 shows the yields on a percentage basis, using Michigan grown Grimm as the standard.

DISCUSSION

Throughout this field-testing program, various alfalfas have been tested, beyond those mentioned in this report. In all, the conclusion has been reached that none of the "common" (purple-blossomed) alfalfas yield as well, or are as generally satisfactory as are Grimm and Hardigan. The new wilt resistant alfalfas have their place. Ladak may be fully equal to Grimm in general usefulness in the northern part of the state, even though it tends to be slow in recovery and poor in fall growth. In areas badly troubled by bacterial wilt of alfalfa, Ranger may equal Grimm by yielding more than Grimm after the first two years. Buffalo alfalfa seems definitely out of its climatic range in most of Michigan, although it is highly resistant to bacterial wilt, and is

apparently a good alfalfa when not injured by cold. All three of the new wilt-resistant alfalfas are less attractive, less green, poorer in blooming, and more troubled by leaf diseases than are Grimm and Hardigan. There is some suggestion that Grimm and Hardigan usually surpass them in seed production, although Ladak has in some cases looked good.

CONCLUSION

Michigan-grown Grimm and Hardigan seed is fully equal to any seed tested for most purposes in Michigan. If but one cutting is taken, Ladak may be superior in hay production, particularly in the north. Ranger can be expected to last longer in soil badly infested with bacterial wilt, particularly if the alfalfa is treated with caution to avoid winter injury.

In areas where winter injury is not a factor, the only reason for considering Buffalo rather than Ranger is that the seed of Buffalo is more readily obtained.

STORAGE OF PEACHES OF DIFFERENT DEGREES OF RIPENESS

By PAULINE PAUL AND M. E. CRAVENS, JR.
SECTION OF FOODS AND NUTRITION AND AGRICULTURAL ECONOMICS

PEACHES THAT ARE to be sold through normal commercial channels must be picked before they reach the soft-ripe stage so that the flesh of the peaches will be firm enough to prevent excessive bruising during picking, sorting, packing and shipping. The problem of how the peaches should be stored for ripening has been investigated by a number of workers. The results obtained differ somewhat with season, locality and type of peach. This paper is a report of a small study made on peaches grown in the Benton Harbor area in the 1948 season. It represents a continuation of the work reported previously (1) on room temperature storage of peaches.

Elberta peaches were obtained directly from the orchard. The peaches were picked by the regular commercial pickers, then hand-sorted into three levels of ripeness—green, hard-ripe and firm-ripe. None of the peaches was ripe enough to be classed as tree-ripe.

The peaches were transported to the laboratory, sorted into small baskets and stored at different temperatures as indicated in Table 1. The holding times at the various temperatures were determined by the number of peaches available and their condition during the test period. The small number of firm-ripe peaches available reduced the possible number of tests for this class. Lots held under refrigeration were changed to room temperature when it became obvious that they would not ripen sufficiently to be edible at the lower temperatures. At the time intervals indicated in Table 1, samples were peeled, sliced, and scored for general appearance, color, odor, flavor, texture and general conclusion. The average general conclusion scores are listed in Table 1. The maximum possible score was 7. Any sample receiving a general conclusion score of 3 or less was usually marked "unacceptable" by the judges.

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Room Temperature—(Lot 1) All the peaches held up satisfactorily for 6 days. The green and hard-ripe peaches improved up to 6 days, after which time the flavor, texture and general conclusion scores decreased, although the color scores remained high. At 2 days the firm-ripe peaches were given the highest scores, with hard-ripe next and green still lower. At 6 days the hard-ripe and green peaches received about equal scores, with the firm-ripe still slightly superior.

Room and Refrigerator—(Lots 2 and 9) These lots were intended to approximate conditions when the consumer purchases peaches which may or may not have been cooled at the packing plant, and then keeps the peaches in cool storage at home. The firm-ripe peaches which had not had preliminary chilling held up satisfactorily for 6 days, after which the flavor deteriorated, and the general conclusion score decreased. Chilling the samples for 2 days before holding at room temperature did not increase the storage life of the peaches materially over that of the non-chilled peaches. The green peaches showed definite improvement in color and texture during storage at 50° F., but the flavor did not improve.

Incubator—(Lot 5) The incubator was small and moisture produced by the respiration of the fruit created an atmosphere of high humidity as well as high temperature. The peaches improved in score for all factors up to 6 days, after which time the scores decreased again, with the exception of the texture of the green samples which continued to improve up to the 12th day. However, this improvement of texture was more than counterbalanced by loss of color and flavor. The hard-ripe sample at 6 days received the highest color score of the entire experiment. However, the firm-ripe peaches held at room temperature throughout were superior in flavor and texture.

Refrigerator, 32° F.—(Lots 6 and 8) One lot (No. 8) was removed from the refrigerator after 9 days, the other lot (No. 6) after 21 days. The peaches kept satisfactorily at 32° F., showing very little tendency to ripen at that temperature. All the samples improved when removed from refrigerator to room temperature. Those held 9 days at 32° F. were best after 5 days at 77° F., then deteriorated, especially in flavor. Of those held 21 days at 32° F., the hard-ripe peaches were satisfactory after 4 days at 77° F., but the green peaches did not develop sufficient flavor to be acceptable.

Refrigerator, 41° F.—(Lot 4) This lot was held at 41° F. for 10 days, then removed to room temperature. The hard-ripe peaches were

TABLE 1—*General conclusion* scores for peaches (maximum possible score 7)*

Lot No.	Location	Average temperature °F.	Stage of ripeness	Average general conclusion scores after days of storage indicated														
				2 days	3 days	4 days	6 days	7 days	9 days	10 days	12 days	13 days	14 days	16 days	17 days	19 days	21 days	23 days	25 days
1	Room	77°	Green	3.0		3.8	5.0			3.8	3.0								
			Hard-ripe	4.0		4.7	5.0			2.8									
			Firm-ripe	5.0		5.5	5.8												
2	Room and Refrigerator	77° for 3 days 50° rest of time	Firm-ripe		4.8		4.8		4.5			3.2							
4	Refrigerator and Room	41° for 10 days 77° rest of time	Green								3.2			4.0		2.0			
			Hard-ripe								3.6			2.0		1.6			
5	Incubator	90°	Green	1.8		2.5	4.0				3.2								
			Hard-ripe	2.0		4.5	5.6				3.4								
6	Refrigerator and Room	32° for 21 days 77° rest of time	Green			1.7			1.3			2.0			1.4		1.2	2.0	2.3
			Hard-ripe			2.5			2.2			2.2			1.6		1.6	2.3	3.7
			Firm-ripe			2.5			3.2			3.0			2.8		1.8		
7	Refrigerator	50°	Green			1.5			2.7			2.7							
			Hard-ripe			3.2			3.7			3.3							
			Firm-ripe			4.5			3.8			3.3							
8	Refrigerator and Room	32° for 9 days 77° rest of time	Green					1.2		2.8	3.0		4.5	3.3					
			Hard-ripe					1.8		2.3	4.8		5.3	4.3					
			Firm-ripe					2.4		4.7	5.2								
9	Refrigerator and Room	41° for 1 day 77° for 2 days 50° for 16 days 77° rest of time	Green		1.6		2.5		2.5			2.6				2.8		3.0	
			Hard-ripe		3.6		4.8		4.3			2.8				3.2			
			Firm-ripe		4.0		5.2		4.0			4.4							
10	Refrigerator and Room	50° for 9 days 77° rest of time	Green					2.2		3.2	3.8		4.3	3.7					
			Hard-ripe					3.2		3.2	4.4		4.0						
			Firm-ripe					4.2		4.2	3.8								

*The general conclusion score represents a comprehensive opinion of the eating quality of the peaches, including all the individual factors such as color, flavor and texture.

satisfactory after 2 days at 77° F., then became unacceptable because of low flavor scores. The green peaches continued to improve in all factors up to 6 days at 77° F., after which the scores decreased again.

Refrigerator, 50° F.—(Lots 7 and 10) Lot 7 was held at 50° F. for 13 days. The firm-ripe peaches decreased steadily in acceptability, owing to lowered flavor scores. The hard-ripe peaches remained about the same throughout the test period. The green peaches improved in color and texture, but only slightly in flavor, not enough to make any of these samples acceptable.

Lot 10 was removed to room temperature after 9 days at 50° F. All these samples improved in color and texture at room temperature. The flavor scores held up or continued to improve for the following lengths of time at room temperature: 1 day for the firm-ripe peaches, 3 days for the hard-ripe peaches, 5 days for the green peaches.

In General—Holding the peaches at room temperature gave the best overall results. Refrigeration lengthened the life of the peaches, but they were not quite as high in eating quality as those which were not refrigerated. The peaches stored under refrigeration tended to develop a mealy texture, as has been reported by other workers (2). This was more pronounced in the samples stored at 50° F. and those stored 21 days at 32° F. Of the samples refrigerated for part or all of the storage period, those held at 32° F. for 9 days, then at room temperature, gave the best results.

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HYBRID SUGAR BEETS IN MICHIGAN

By H. L. KOHLS
SECTION OF FARM CROPS

UNTIL RECENTLY it has been very difficult to make use of hybrid vigor to increase yields of sugar beets because of the large amount of self- and sib-pollinating that usually takes place. The morphology of the flower is such that it is impractical to emasculate a large number of flowers. Recently cytoplasmically inherited male-sterility has been found in sugar beets and it lends itself readily to mass hybridization.[1]

The Station received in 1945, from Dr. F. V. Owen of the Division of Sugar Plant Investigations, U.S.D.A., a few plants that were male-sterile. The plants were divided into five groups and each group was pollinated by a different inbred strain. The progeny from the male-steriles of each group was observed at flowering time, and of two of these hybrids one hybrid was 100 percent male-sterile and the other nearly so. These two hybrids were back-crossed to their respective pollen parents. The seed was again taken from the male-steriles. This seed was then planted in the field to produce a large number of roots for crossing the following year. These two female lines are known as Ac. 32—57301E_2 and Ac. 35—410603E_2. In 1947, 17 hybrids were made by pollinating these two female lines by other inbred male lines.

Previous to this work the author had attempted to cross Ac. 32—35701 with U. S. 216 but failed because of the low percentage of crossing that took place. He did, however, observe that a few plants were very large and vigorous and appeared to be very desirable hybrids. Therefore in 1945, when male-sterile plants were available, he started to develop a male-sterile strain equivalent to Ac. 32—57301 to be crossed with U. S. 216. This was accomplished in 1946 and in the same year arrangements were made with the Farmers and Manufacturers Beet Sugar Association to pollinate this strain with U. S. 216 for a commercial hybrid of sugar beets. This cross is known as Hybrid 125.

[1]Cytoplasmically Inherited Male-sterility in Sugar Beets, by F. V. Owen. Jour. Agr. Res., 71: (10) Nov. 15, 1945.

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TABLE 1—*A comparison of hybrids 125 and 148 and their parents at Blissfield, Michigan, in 1948. The data are in terms of U. S. 215 x 216/3 as 1.00*

Variety		Tons per acre	Percent sugar	Percent purity	Recoverable sugar per acre	Smoothness of root	Resistance to leaf spot
Ac. 32–57301 E[2]	female..	.59/	.95	.99	.57/	1.01	.99
Hybrid 125	hybrid..	1.12‡	.97	.99	1.11‡	1.00	.90/
U. S. 216	male....	.90*	1.00*	1.00*	.90*	1.00*	.95*
Ac. 35–410603 E[2]	female..	.66/	.96	1.00	.51/	.95#	.98
Hybrid 128	hybrid..	1.19‡	.94/	.99	1.10	.98	.99
Ac. 32–57305	male....	.57/	.94/	1.01	.53/	1.02	1.03†

†Statistically significant above the standard at the 5% level.
‡Statistically significant above the standard at the 1% level.
#Statistically significant below the standard at the 5% level.
/Statistically significant below the standard at the 1% level.

*No data are available but estimates were made from previous observations.

Hybrid 125 and the 17 hybrids referred to previously were tested in suitable 6-by-6 Latin squares at Blissfield, Michigan, in 1948. Two hybrids, 125 and 148, were found to be very desirable in comparison to the commercial variety commonly grown in the state. Table 1 shows the hybrid vigor of these two hybrids as exhibited by their relatively high yields per acre.

Hybrid 125 was tested in nine locations in the eastern sugar beet area in comparison with U. S. 215 x 216/3, the commonly grown commercial variety.[2] Eight-by-eight Latin squares were used except at Blissfield where a 6-by-6 planting design was used and at East Lansing on muck soil the design was a randomized block replicated four times. In this paper all varieties are omitted except Hybrid 125, U. S. 215 x 216/3 and the "Muck Variety" because they have no bearing on the data, to be reported. The Muck Variety was included in only one test.

Table 2 gives the comparative data involving Hybrid 125 from 9 tests in the eastern sugar beet area. On muck soil at East Lansing Hybrid 125 was higher yielding than the commercial and the Muck Variety but the Muck Variety was higher than the other two in percentage of sugar. There was no difference between the three in recoverable sugar per acre. At Reese there was no difference between the hybrid and the commercial. But in the other seven tests Hybrid 125 outyielded the commercial in both tonnage and pounds of recoverable sugar per acre. In all tests, Hybrid 125 averaged 12½ percent more

[2]Cooperators in these tests include G. H. Coons and J. G. Lill, Division of Sugar Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture; Perc A. Reeve and Grant Nickol, Farmers and Manufacturers Beet Sugar Association; Paul M. Harmer and John F. Davis, Soil Science Department, Michigan State College; H. H. Heilman, Great Lakes Sugar Co. and B. E. Easton, Canada and Dominion Sugar Co.

TABLE 2—*A comparison of hybrid 125 and U. S. 215 x 216, 3 as grown in several Michigan locations in 1948*

Location and variety	Tons per acre	Percent sugar	Percent purity	Recoverable sugar per acre in lbs.	Smoothness of root	Resistance to leaf spot
Old Fort, Ohio..... H 125	25.27‡	17.10	81.66	7053†	.....	
215 x 216	22.66	17.04	82.34	6441	.....	
Latty, Ohio..... H 125	21.78‡	18.19	82.68	6551‡	....	
215 x 216	18.93	18.19	83.07	5716		
East Lansing, Michigan..... H 125	8.77‡	16.46	82.52	2385	.....	.....
215 x 216	7.23	15.94	81.58	1895	.....	.....
Merrill, Michigan..... H 125	18.74‡	18.22	81.75	5584‡	....	
215 x 216	15.79	18.28	82.63	4775	.....	
Saginaw, Michigan..... H 125	17.77‡	19.49	85.33	5909	....	
215 x 216	15.31	19.00	84.49	4915	.....	
Reese, Michigan..... H 125	18.17	19.39	85.08	5986		
215 x 216	18.72	19.32	84.92	6169		
Chatham, Canada..... H 125	9.38†	17.06	.....	3165†	.....	.....
215 x 216	8.22	17.14	.....	2797	.....	.....
East Lansing, Michigan (on muck soil)						
H 125	21.69‡	14.33	86.09	5355	.....	.....
Muck variety	17.60	17.33‡	87.49	5345	.....	.....
215 x 216	19.03	14.40	85.66	5009	.....	.....
Blissfield, Michigan..... H 125	20.39‡	15.97	90.51	5928†	8.42	8.00
215 x 216	18.16	16.39	90.97	5326	8.38	8.92
Average of all locations..... H 125	18.00‡	17.36	84.45	5324‡	.....	
215 x 216	16.01	17.29	84.46	4779		

†Statistically significant above the standard at the 5% level.
‡Statistically significant above the standard at the 1% level.
#Statistically significant below the standard at the 5% level.
/Statistically significant below the standard at the 1% level.

in tonnage and over 11 percent more in recoverable sugar per acre. It was not so resistant to leaf spot as the commercial.

The data presented here indicate that the use of cytoplasmically inherited male-sterility is a practical method of mass hybridization of sugar beets. This opens a large field for sugar beet improvement, particularly in increased yields due to hybrid vigor. It is now possible to get 100 percent crossing between strains and make full use of hybrid vigor, a thing that was not possible by previous methods. In the future —when a greater number of male-sterile inbred lines are available from which to select, and when a much greater number of combinations between strains can be made—breeders can reasonably expect to find hybrids that will be far more productive than those of today.

CONSUMER RESPONSE TO CHICKENS IN 1948

By H. E. LARZELERE and J. B. LEAVER[1]
ECONOMICS SECTION

THE PRODUCTION and marketing of broilers and friers were one of the 4-H Club projects in Kent County, Michigan in 1948. In August, about 2,500 of the chickens were feather-dressed (New York dressed) in a modern poultry dressing plant and sold at retail by a chain store organization through its outlets in western Michigan. As part of a complete appraisal of the project, a questionnaire was developed to give purchasers of the chickens an opportunity to indicate some of their general preferences in buying chickens and to express their ideas regarding the particular chickens which they obtained. The analysis of the results of these questionnaires had two objectives: 1) to assist poultry processing plants and retail establishments who handle chickens to satisfy the preferences of the eventual consumers, and 2) to serve as a guide for these young poultrymen in their future poultry production and marketing enterprises.

While no information has been obtained which could link certain preferences to such factors as personal income, race, or religion of the various consumers, the writers feel that the attitudes reported here will fairly well indicate the ideas regarding chickens of a large number of consumers in the area.

One hundred and fourteen purchasers returned questionnaires. The questions and answers are given in the following tables and form the basis of this report.

TABLE 1—*How long has it been since you bought a chicken?*[2]

Reply to Question	Percent
A few days	8
A week	32
Over a week but less than a month	29
A month or more	27
Did not answer question	4
Total	100

[1]The writers acknowledge the assistance given in this survey by the following agencies and persons: the Kent County Extension Office, the cooperating retail chain store organization; J. M. Moore, Poultry Husbandry Department; E. A. Shuler, Sociology and Anthropology Department, Michigan State College; and the consumers who returned the questionnaires.

[2]The title of each table in the report represents one of the questions on the questionnaire.

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TABLE 2—*Why haven't you bought chicken more often?*

Reply to Question	Percent	Percent of those giving a reason
Too expensive	20	27
Could not get desired kind	18	24
Do buy often	12	17
Like variety	10	13
Other reasons	14	19
Did not answer question	26	..
Total	100	100

Table 1 indicates that well over half of the consumers answering the questionnaire had not purchased a chicken within a week. The reasons for not buying chicken more often are given in Table 2.

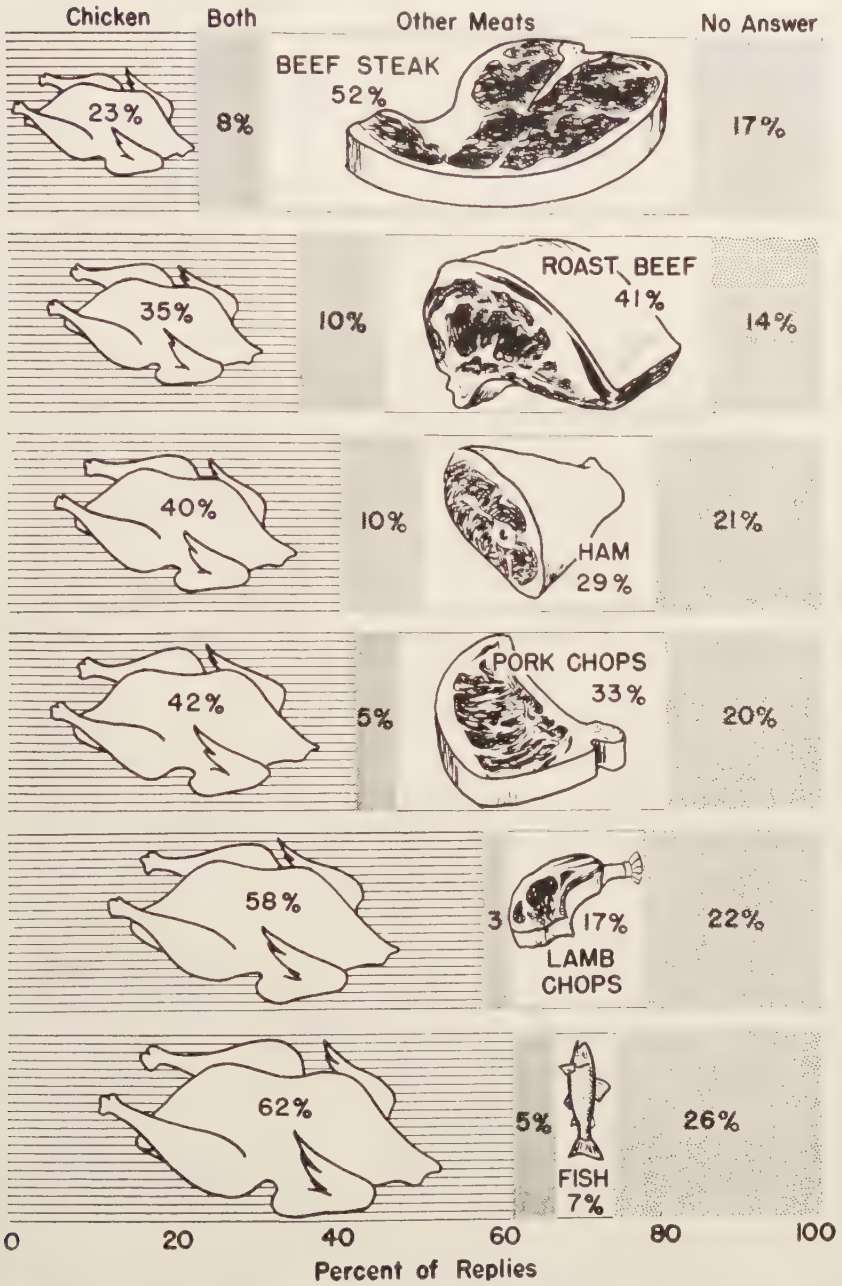
More than a fourth of the consumers who gave a reason for not buying chicken more often felt chicken was too expensive a meat, whereas slightly less than a fourth reported they could not get the desired quality. This latter observation, particularly, is a challenge to both poultry producers and marketing agencies.

In order to learn their preference regarding chicken and other meats, the consumers just mentioned were asked to choose between chicken and each of six other kinds of meat (or fish). The results are shown in Fig. 1 and indicate that chicken is preferred to pork chops, lamb chops, ham, and fish, but that roast beef and beef steak[3] are preferred over chicken. It must be emphasized, however, that these selections were made regardless of cost. Therefore, taking into account the previous observation that some consumers felt that chicken was too expensive, some folks would likely purchase a less expensive type of meat, even though chicken was preferred.

TABLE 3—*How did this chicken look to you before cooking? (Check one in each column)*

Replies	Percent	Replies	Percent
Very clean	79	Very plump	3
Fairly clean	16	Plump	84
Not clean	2	Thin	10
Did not answer	3	Did not answer	3
Total	100	Total	100
Very few feathers	85	Too much fat	0
Too many feathers	4	Fair amount of fat	90
Did not answer	11	Not enough fat	3
		Did not answer	7
Total	100	Total	100

[3]This group of consumers was selected because they had purchased a chicken. They might, therefore, tend to emphasize the popularity of chicken more than would the so-called average consumer.



*"Both" refers to the percentage of respondents who apparently liked both chicken and the respective meat (or fish), but did not wish to make a choice of one or the other.

Fig. 1. Preference in response to the question, "In each of the following pairs, check the meat that seems to be most popular with your family, regardless of cost."

The attitude toward the condition of the particular bird which the customer purchased can be observed in Table 3. The great majority of the customers felt that the 4-H club chickens which they obtained were very clean, had few feathers left on the carcass, were satisfactorily plump, and had a reasonable amount of fat. In addition, 15 voluntary comments appeared and all were complimentary. To illustrate, three are quoted below.

"I purchased 4 of your fryers—my one regret is these 4-H Club birds are not available to us all year around. They were delicious."

"I bought 2 last week for the first time and they were the cleanest I ever got in a market before. And they were nicely filled out and very tasty. I'm glad to let you know this. Thank you."

"The '4-H Tag' on the chicken was what drew my attention, and my faith in the products of the members of the organization was not misplaced. The chicken was plump, juicy, and delicious."

These responses indicate that these particular chickens met with great satisfaction as far as their purchasers were concerned.

TABLE 4—*What kind of chicken do you prefer? (Check one in each column)*

Replies	Percent	Replies	Percent
Plumper than this one	24	More fat than this one	9
About like this one	73	About like this one	81
Less plump than this	0	Less fat than this	1
Did not answer	3	Did not answer	9
Total	100	Total	100

Table 4 indicates that most of the respondents would like to obtain regularly chickens equal to these 4-H club birds. A few would have preferred a plumper and/or fatter chicken than the one they obtained. More than three-fourths of the consumers preferred the springer-type chicken to any of the others; however, the opinion of the particular purchasers of these chickens may have been biased. It should be recalled that all of these chickens were of the springer type, therefore, consumers who preferred other types probably would not have bought one of these chickens and would not have received a questionnaire. As to preparation of chicken, more than 60 percent preferred the frying method. The customers answering this questionnaire, however, again may have been inclined to favor the frying method because of their purchase of this type of chicken.

TABLE 5—*What way of preparing chickens is most popular with your family?* More than one answer could be given.*

Replies	Percent
Fry	61
Roast	24
Stew	6
Steam	2
Boiled—then fried	4
Uncertain	3
Total	100

In answer to the question "If you had your choice regardless of cost, which (one or more parts) would you buy?", 68 percent of the purchasers would buy a whole chicken alone or along with one or more selected parts. Fifty-four percent would purchase drumsticks or thighs, and 40 percent breasts alone or along with other parts. In contrast only 10, 7, and 3 percent would buy wings, giblets, and backs, respectively. These figures indicate some of the preferences in buying chicken meat by the piece. They also show the relative amount of differences that would be expected among prices for whole chickens and those for various parts.

In indicating the preference for purchasing their chicken, 40 per-

TABLE 6—*If you had your choice, which one way would you prefer to buy your chickens? Why do you prefer it this way?*

Preference	Number of purchasers	Reason	Number of purchasers
Live	4	Like to fix it to suit self	2
		Fresher	1
		Reason not given	1
Live-dressed and drawn while you wait	29	Fresher	20
		Better flavor	9
Drawn while you wait	28	Fresher	11
		Rather cut to suit self	8
		Know what you're getting	3
		Only way available	2
		Reason not given	4
Whole, ready to cook	18	Fresher	4
		Convenient	6
		Rather cut it to suit self	5
		Reason not given	3
Whole and frozen	1	Reason not given	1
Cut up, ready to cook	31	More convenient	25
		Do not like to clean it	4
		Reason not given	2
Cut up and frozen	3	Convenient	2
		Fresher	1

*The replies indicated 76 percent preferred springers, 16 percent hens, and 8 percent other types.

cent of the customers preferred to buy them ready-to-cook, either whole or cut-up, whereas approximately one-fourth of the customers preferred them to be only feather-dressed until they had seen them and waited for them to be drawn. More than one-fourth preferred to see the chickens alive at the time of buying. The reasons given for these various choices are shown in Table 6.

Consumers preferring to buy either as live, or live-dressed-and-drawn while you wait, or drawn-while-you-wait, believed that chicken, bought in these ways would be fresher and therefore more desirable. On the other hand, those preferring to buy the chickens in a dressed and ready-to-cook manner, did so because of the element of convenience.

TABLE 7—*If the price for a chicken sold on a ready-to-cook weight basis were about 20 cents per pound above the price for a similar chicken sold on an undrawn weight basis, which would you prefer to buy?*

Replies	Percent
Buy on the ready-to-cook weight	59
Buy on the undrawn weight	37
Uncertain	4
Total	100

Nearly 60 percent of the purchasers preferred to buy the chicken on a ready-to-cook weight basis if the price were 20 cents a pound above the price for a similar chicken sold on an undrawn weight basis. The render will observe that in answering this last question, more people preferred to buy on a ready-to-cook weight basis than was indicated in Table 6. Apparently, the use of a definite differential influenced their choice in this matter. The 20-cent difference in price between the price per pound for the ready-to-cook weight and the undrawn-weight was the customary differential during the time of this study. It was estimated that this differential made the net cost to the purchaser for the edible portions of the chicken about the same regardless of the method of sale. It should be recalled that generally when the chicken is bought on an undrawn-weight basis, the retailer draws the chicken after the customer has made his selection and the buyer therefore receives only the ready-to-cook portions.

Under these conditions, it would be immaterial to the retailer which method of sale was used. However, the ready-to-cook method would permit the retailer to have the drawing process done more economically

at a poultry dressing plant or at least during slack business hours and not take the time of a salesman-clerk at the time of actual purchase when other customers are waiting.

In summary: **First,** consumers would purchase more chickens if there were more birds readily available that have the meat quality and market preparation of the chickens concerned in this project.

Second: More chickens could also apparently be sold if methods were found to make them less expensive to the consumer as compared with other meats.

Third: A larger proportion of chickens of desirable quality could be sold on a ready-to-cook-weight basis and thereby probably effect some economies in retailing costs. This method of sale would be more popular, especially, if the purchaser felt that he paid no more for the edible portion of the bird than if he had purchased it on some other basis.

THE EFFECT OF METHOD OF PROCESSING ON EATING QUALITY AND VITAMIN C RETENTION OF PEAS

By MABEL LOU PIAN and PAULINE PAUL
SECTION OF FOODS AND NUTRITION

THE QUESTION of proper food preservation is of interest to all homemakers. There are four principal methods by which food may be preserved: 1) salting, 2) canning, 3) drying, and 4) freezing. Each method has its own advantages and disadvantages. The purpose of this study was to compare the eating quality and vitamin C retention of peas preserved by these four different ways.

EXPERIMENTAL PROCEDURE

The peas used were grown on the Research Farm of the Michigan State College. They were firm and ripe when processed.

The processing methods used followed standard recommendations (1, 2, 3, 5). Details are given in Table 1. Samples were scored for palatability and tested for vitamin C content at the following stages: fresh; freshly processed (no storage); after 3 months' storage. The method of analysis used for vitamin C was that of Loeffler and Ponting (4) for reduced ascorbic acid.

Samples of each lot of peas were cooked and scored to determine the eating quality. Scoring factors considered included appearance, color, odor, flavor, texture and general conclusion. The scoring scale ranged from 1 to 7, 1 being very poor and 7 excellent.

RESULTS

The average scores for the peas are given in Table 2. The frozen peas were given the highest scores throughout, with the canned peas second. The dehydrated and the salted peas were not acceptable when eaten alone, although several of the judges commented that they would have been satisfactory if combined with other foods as in soup or stew.

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TABLE 1—*Methods used in preparation of peas*

Method of Processing	Preparation	Pre-heating	Processing	Storage	Preparation for Scoring
Canning	Shell and wash	Bring to boil	Pack in pint jars, process 40 minutes at 10 pounds pressure	3 months at room temperature	Bring to boil, serve hot
Freezing	Shell and wash	2½ minutes in steam, cool in running water	Pack in pint cartons, seal, freeze at 0°F.	3 months at 0°F.	Cook ⅔ pound peas in ¾ cup water, 2 minutes, serve hot
Dehydrating	Shell and wash	5 minutes in boiling water	Spread on shallow trays, dry at 175-195°F. with fan on until dry enough to shatter (about 14 hours). Pack in pint jars	3 months at room temperature	Soak 1½ cups dried peas in 2½ cups water for 30 minutes. Boil 20 minutes, serve hot
Salting: I (in the pod)	Mix 9 pounds unshelled peas and 1 pound salt. Cover with brine of 1½ pounds salt and 1 cup vinegar to 1 gallon of water. Let stand 2 weeks	None	After 2 weeks, shell peas, repack in pint jars, cover with same brine	3 months at room temperature	Soak overnight in 1 gallon water to 1 pound shelled peas. Drain, cover with fresh water, bring to boil, serve hot
II (shelled)	Shell and wash	None	Mix 1½ pounds salt with 8 pounds shelled peas, cover with brine of 1½ pounds salt, 1 cup vinegar and 1 gallon water, pack in pint jars	3 months at room temperature	Same as for I

TABLE 2—*Average scores for peas (maximum possible score, 7)*

Method of processing	Length of storage	Scoring factor					
		Appearance	Color	Odor	Flavor	Texture	General conclusion
Canning	None	5.0	3.8	4.6	4.2	4.5	4.3
	3 months	4.9	4.8	4.0	4.4	4.4	4.3
Freezing	None	5.7	5.7	5.5	5.5	5.0	5.6
	3 months	6.3	6.3	5.8	5.3	4.8	5.5
Dehydrating	None	4.0	4.2	4.5	3.9	2.6	2.6
	3 months	3.3	3.3	2.9	3.0	2.0	2.3
Salting (in the pod) I	None	5.6	4.2	4.4	2.8	3.7	3.4
	3 months	5.2	5.2	2.7	3.4	3.3	3.0
(shelled) II	None	4.4	4.0	3.3	1.9	4.2	2.2
	3 months	5.3	4.9	2.9	2.2	4.5	2.7

The percent of vitamin C retained in the various samples is shown in Table 3. Again, freezing gave the best results. Salting in the pod gave the next best, and canning was third. Leaving the peas in the shell during part of the salting process probably helped to reduce the loss by solution of vitamin C.

TABLE 3—*Vitamin C values for peas (percent of original content)*

Method of Processing		No storage	3 months' storage
Canning		32.0	26.7
Freezing		59.6	89.8
Drying		27.9	0.0
Salting (in the pod)	I	50.0	39.1
(shelled)	II	20.5	20.2

SUMMARY

A comparison has been made of the eating quality and vitamin C content of peas preserved by canning, freezing, drying and two methods of salting.

Frozen peas gave the best results, both for eating quality and for retention of vitamin C. Canned peas were second for eating quality, and peas salted in the shell were second for vitamin C retention. Although the judges did not like the dried or salted peas when served plain, they thought these peas would be acceptable when mixed with other foods.

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CUSTOM RATES CHARGED FOR FARM WORK IN MICHIGAN IN 1948

*By B. R. BOOKHOUT and R. W. CHRISTIAN**
SECTION OF FARM MANAGEMENT

MANY REQUESTS have come to the Farm Management Department, asking for information on current custom rates. The rates shown in this report were obtained from reports sent in by over 500 Michigan farmers doing custom work.

Custom work is one method of solving the problem of making fewer machines serve more farmers. Custom work enables the operators of smaller farms to obtain the efficiency of large machines which they could not afford to buy. Other methods are sharing work and owning machinery jointly.

The use of custom work by Michigan farmers has increased in the last few years. Farm machinery and labor have been scarce during the years of the war and post-war period. Farm equipment is now available but at prices above the pre-war levels. Many farmers are looking to custom work as a means of getting the work done without an investment in machinery out of line with their farm business. Other farmers have purchased large machines and are looking for work on a custom basis to help carry the high investment and, in many instances, to supplement the farm income.

Many farmers reported only one or two types of custom work. One farmer might report work with a combine and a plow or disk. Another farmer might report custom baling. Some of the reports, however, gave rates for work with many types of farm equipment. These operators evidently regard custom work as a major source of income rather than as a means of spreading costs or supplementing the farm income.

The "most common rate" for the usual sizes of farm equipment are listed in this report. Some farmers reported rates below and some above these common rates. The lower rates were usually accompanied

*The authors appreciate the cooperation of the farmers who gave the information, and the assistance of the County Agricultural Agents and other members of the Farm Management Department.

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with a note such as, "level field", "good going", or "no stones". The higher rates were frequently near cities where the wage rates and other costs tend to be higher. The higher rates were also reported for difficult field conditions. For example, many farmers reported a charge of 50 cents more per acre for plowing alfalfa sod, stony ground, or rough fields.

The "usual range" shown in the tables covers at least two-thirds of the rates reported for a given job. Some of the very high and very low rates were for unusual conditions and were not included in the usual range.

Custom work rates in the southern half of the lower peninsula were reported mostly on an acre basis. In the northern part of the lower peninsula and the upper peninsula, the rates were usually given on an hourly basis. In general, the acre rates were used where field conditions were fairly uniform from farm to farm. Where there was greater difference in field conditions, the hourly rates made a fairer basis for custom work payments.

The size of the machine had little effect on the custom rates on an acre basis. On an hourly basis, however, the rates varied with the size of the machine. Larger machines have a greater cost but do more work per hour. Thus, their rates per hour are higher, but the charges per acre remain about the same.

PLOWING, FITTING AND CULTIVATING

TABLE 1—*Plowing, fitting, and cultivating custom rates in 1948 (Rates include machine, tractor, and operator)*

Operation	Acre rate		Hourly rate		Average acres per day
	Most common rate	Usual range	Most common rate	Usual range	
Plowing					
2-bottom	$4.00	$3.50–4.50	$3.00	$2.50–3.50	8
3-bottom	4.00	3.50–4.50	4.00	3.50–4.50	12
Disking					
7-foot and under	1.00	0.75–1.25	3.00	2.50–3.50	21
8-foot and over	1.00	.75–1.50	3.50	2.50–4.00	28
Dragging					
2-section	1.00	.75–1.25	3.00	2.50–3.50	25
3-section	.75	.50–1.00	3.00	2.50–3.50	36
4-section	.75	.50–1.00	3.00	3.00–3.50	40
Field cultivating					
All machines	1.25	1.00–1.50	2.50	2.00–4.00	11
Cultivating					
2-row	1.00	.75–1.50	3.00	2.50–3.00	20
4-row	1.00	.75–1.50	.....	.....	28

DRILLING AND PLANTING

TABLE 2—*Drilling and planting custom rates in 1948 (Rates include machine, tractor, and operator except as noted for planting potatoes)*

Operation	Acre rate		Hourly rate		Average acres per day
	Most common rate	Usual range	Most common rate	Usual range	
Grain drilling					
13-hole or under					
without fertilizer	$1.50	$1.00–1.50	$3.00	$2.50–3.00	20
with fertilizer	1.50	1.00–2.00	3.00	2.50–3.50	20
14-hole or over					
without fertilizer	1.50	1.00–1.50	3.00	2.50–3.50	24
with fertilizer	1.50	1.25–2.00	3.00	2.50–3.50	24
Bean drilling					
2-row	1.75	1.50–2.00	2.50	2.50–3.00	15
4-row	1.50	1.00–2.00			24
Grain drill	1.50	1.25–1.50			25
Corn planting					
2-row					
without fertilizer	1.25	1.00–1.50	3.00	2.00–3.50	20
with fertilizer	1.50	1.25–2.00	3.00	2.50–3.50	17
4-row					
without fertilizer	1.50	1.00–2.00			30
with fertilizer	1.50	1.25–2.00			25
Potato planting					
1-row—operator only			2.00	2.00–2.50	6
2-row—operator only	3.50	2.50–4.00	4.00	3.50–4.50	11
2-row—operator and 1 man	4.00	3.50–4.00	4.00	3.00–5.00	10

SPRAYING AND DUSTING

The rates for spraying row crops and fruit varied with the size of the spray tank, the capacity of the pump, and the number of men furnished. The rates in the foregoing table include sprayers of different sizes and capacities. Therefore the rates should be considered as

TABLE 3—*Spraying and dusting custom rates in 1948 (Rates include sprayer, tractor, and operator except as noted)*

Operation	Basis of charge	Most common rate	Usual range
Spraying potatoes			
	Hour	$3.00	$3.00–4.00
	Acre	2.00	1.50–2.50
	Gallon	0.02	.01½–.02
Dusting potatoes			
	Acre	1.50	1.25–2.00
Spraying tree fruit			
1 man furnished	Hour	3.50	3.00–5.00
2 men furnished	Hour	4.00	4.00–5.00
All	Gallon	.02	.01½–.02½
Spraying small fruit			
	Acre		2.00–3.00
Spraying weeds with 2,4-D			
Material included	Acre	4.00	3.00–5.00
Material not included	Acre	2.00	1.50–2.50

guides rather than definite standards. Most custom operators varied the rates, depending on the size of the job, ease of obtaining water, topography of the orchard, size of trees, and other factors that affect the amount of spray that can be applied in a given time.

The custom rates reported for the newer types of work such as field chopping, loading manure with a tractor loader, and spraying with 2,4-D for weed control varied more than the rates for work with more conventional types of equipment. The rates for these newer jobs are likely to change as farmers become more familiar with the equipment.

MOWING AND RAKING HAY

TABLE 4—*Mowing and raking custom rates in 1948 (Rates include machine, tractor, and operator)*

Operation	Acre rate		Hourly rate		Average acres per day
	Most common rate	Usual range	Most common rate	Usual range	
Mowing hay					
5-foot mower	$1.00		$2.50	$2.00–2.50	9
6-foot mower	1.25	$1.00–1.50	2.50	2.00–3.00	19
7-foot mower	1.00	1.00–1.50	3.00	2.50–3.50	26
Raking hay					
Side delivery rake	1.25	1.00–1.25	2.50	2.00–3.00	26

FIELD CHOPPING

TABLE 5—*Field chopping custom rates in 1948*

Operation	Hourly rate		Average acres per day
	Most common rate	Usual range	
Hay chopping			
Chopper and blower with:			
1 man—2 wagons—1 tractor	$8.00	$7.00-10.00	9
2 men—2 wagons—2 tractors	10.00	10.00–12.00	18
2-4 men—trucks—2 tractors	12.00	10.00–12.00	
Straw chopping			
Chopper and blower with:			
1 man—2 wagons—1 tractor	8.00	7.00–10.00	16
2 men—2 wagons—2 tractors	10.00	8.00–12.00	18
Corn chopping			
Chopper and blower with:			
1 man—2 wagons—1 tractor	8.00	8.00–10.00	8
1 man—2 wagons—2 tractors	9.00	8.00–10.00	
2 men—2 wagons—1 tractor	8.00	8.00–10.00	9
2 men—2 wagons—2 tractors	10.00	10.00–12.00	8
2 or 3 men—trucks—2 tractors	10.00	10.00–12.00	

The reports for field chopping did not give complete information on the size of chopping equipment. However, from the information received the hourly rates were slightly higher for the larger machines. There was little difference in the acre rates but the larger machines covered great acreages per day.

A few farmers with field choppers reported a charge per hour for the use of the equipment in the field and a charge per foot for the equipment used at the silo. The usual rates reported were $6.50 per hour for the field work and $1 to $2 per foot for filling silo.

CUTTING GRAIN AND THRESHING

TABLE 6—*Cutting grain and threshing custom rates in 1948 (Rates include machine, tractor, and operator)*

Operation	Acre rate		Average acres per day
	Most common rate	Usual range	
Grain cutting			
6-foot binder	$2.00	$1.50–3.00	12
7-foot binder	3.00	2.00–3.50	13
8-foot binder	3.00	2.00–3.50	16
10-foot binder	2.00	1.50–2.50	19
	Rate per bushel		
Threshing			
Wheat	$0.08	$0.06–0.10	
Barley	.07	.06– .08	
Oats	.06	.05– .07	
Rye	.08	.08– .10	
Beans	.20	.15– .25	
Alfalfa seed	2.50	1.50–3.50	
Clover seed	2.50	1.50–3.50	

Threshing rates for alfalfa and clover seed were also reported on an hourly basis and on the basis of weight of seed. In some cases the yield of seed determined the basis of charge. The usual rates per hour were $5, but the reports ranged from $4 to $6 per hour. On the basis of weight, the rates reported were from 4 to 6 cents per pound.

COMBINING

Combining alfalfa and clover seed for a share of the seed was reported by about 10 percent of the farmers who combined these crops. The usual share was one-half of the seed, but a few reported a one-third share, especially when the yield was high.

TABLE 7—*Combining custom rates in 1948 (Rates include machine, tractor, and operator)*

Operation	Acre rate		Hourly rate		Average acres per day
	Most common rate	Usual range	Most common rate	Usual range	
Small Grain					
3½ to 4½ foot combine	$5.00	$4.00–6.00	$4.50	$4.00–5.00	8
5-foot combine	5.00	4.00–6.00	5.00	4.00–6.00	11
6-foot combine	5.00	4.00–6.00	6.00	5.00–6.00	12
7 to 12-foot combine	5.00	4.00–6.00			
Field beans					
5-foot combine	5.00	4.00–5.00			11
6-foot combine	5.00	4.50–6.00	4.00		11
Special bean combine	6.00	6.00–7.00			18
Soybeans					
5-foot combine	5.00	4.00–5.00			11
6-foot combine	5.00	4.00–5.00			12
Alfalfa seed					
3½ to 4½-foot combine	5.00	4.50–5.00			8
5-foot combine	5.00	4.00–5.00	5.00	5.00–6.00	9
6-foot combine	5.00	4.00–5.00	5.00	5.00–6.00	10
7 to 12-foot combine	5.00	4.00–6.00			13
Clover seed					
3½ to 4½-foot combine	5.00	4.00–5.00			8
5-foot combine	5.00	4.00–5.00	5.00	4.00–6.00	9
6-foot combine	5.00	4.00–5.00	5.00	5.00–6.00	10
7 to 12-foot combine	5.00	4.00–5.00			16

FIELD BALING

TABLE 8—*Field baling custom rates in 1948 (Rates include machine, tractor, and operator except as noted)*

Baler and crew	Baling hay			Baling straw		
	Most common rate	Usual range	Average tons per day	Most common rate	Usual range	Average tons per day
Automatic baler						
Rectangular bale						
String tie:						
with towed wagon	$0.12	$0.12–0.13	27	$0.13	$0.12–0.14	17
without towed wagon	.12	.10– .14	27	.12	.10– .14	21
Wire tie	.13	.10– .14	34	.15	.14– .15	20
Round bale—string tie	.12	.10– .13	23	.12	.10– .12	20
3-man baler						
Operator and 2 men:						
with towed wagon	0.15	0.14–0.16	23	0.15	0.14–0.16	16
without towed wagon	.14	.12– .15	24	.15	.13– .16	17

Towing a wagon behind the baler was reported by 23 percent of the operators of automatic string tie balers. Thirty-six percent of the reports for 3-man balers included a wagon towed behind the baler.

PICKING CORN AND FILLING SILO

TABLE 9—*Picking, cutting, shredding corn, and filling silo custom rates in 1948 (Rates include the machine, tractor, and operator except as noted)*

Operation	Acre rate		Hourly rate		Average acres per day
	Most common rate	Usual range	Most common rate	Usual range	
Corn picking					
1-row picker	$5.00	$4.00–6.00	$5.00	$4.50–5.00	8
2-row picker	4.00	4.00–5.00			14
Corn cutting					
Binder only	4.00	3.00–5.00	3.50	3.00–4.50	8
Binder with loader	4.00	3.00–5.00	5.00	4.50–5.00	8
Corn shredding					
Operator only			4.00	3.50–4.50	
Operator and 1 man			5.00	4.00–5.00	
Silo filling					
All silos			4.00	3.00–5.00	
	Rate per foot				
10-foot silo	.75	.75–1.00			
12-foot silo	1.00	.75–1.25			
14-foot silo	1.00	1.00–1.25			

HARVESTING SUGAR BEETS

The use of mechanical sugar beet harvesters for custom work was reported by about 20 farmers. The most common rate reported was $20 per acre. Rates ranged from $15 to $27 an acre. About one-half of the farmers indicated that the rate was based on the yield and was the same as the cost of harvesting with hand labor. Some rates were given as a minimum of $15 to $17 with increases above this minimum based on the yield and hand labor rates.

The acreage of sugar beets harvested per day with mechanical harvesters averaged 4.2 acres a day. The reports ranged from a low of 2.5 acres to a high of 6 acres harvested a day.

SPREADING LIME

The usual practice reported for handling lime was to contract for the lime spread on the field. The price differs between areas since in most cases the price is determined by bids submitted by contractors. A contractor may bid to deliver lime at a given price within a given area. Outside that area, an additional charge per mile is added for trucking. In other areas, the contractor bids for the lime contracts, with mileage charges starting at the loading point with no base area.

The rates reported by 25 contractors and farmers for lime spread on the field averaged $3.85 per ton. The rates ranged from $3.50 to $5.00, depending mostly upon the hauling distance. Several reports gave the charge for spreading separate from the total charge. Rates for spreading were between 50 and 60 cents per ton in most cases.

OTHER CUSTOM WORK

TABLE 10—*Custom rates for other operations in 1948 (Rates include machine, tractor, and operator except as noted)*

Operation	Basis of charge	Most common rate	Usual range
Digging potatoes	Hour	$4.00	$3.00– 5.00
	Acre	6.00	5.00– 7.50
Picking potatoes	Bushel	0.08	0.08– 0.10
Loading manure with tractor loader	Hour	3.50	2.00– 5.00
Spreading manure	Hour	2.50	2.00– 3.00
Bulldozing	Hour	8.00	7.00– 9.00
Buzzing wood	Hour	2.50	2.00– 3.00
Sawing lumber	1,000 bd ft.	15.00	12.00–18.00
Grinding feed	Bushel	0.06	
Trucking			
General	Hour	3.00	2.50– 3.00

MACHINERY RENTAL

TABLE 11—*Machinery rental rates in 1948*

Machine	Basis of charge	Average rate	Usual range
Grain drill	Acre	$0.65	$0.50 -1.00
Bean drill	Acre	.75	
Corn planter	Acre	.85	.75–1.00
Potato planter	Acre	1.85	1.50–2.00
Lime spreader	Acre	.40	.30– .50
Conveyor			
Hay or straw	Bale	.01	
Small grain	Acre	.75	.50–1.00
Ear corn	Acre	.75	.50–1.00
Tractor			
1-plow, alone	Hour	1.50	
2-plow, alone	Hour	2.00	
2-plow, with operator	Hour	2.90	2.50-3.00

TRACTOR VINE LIFTERS

By J. F. DAVIS and G. W. FRENCH

Section of Soil Science, Michigan Agricultural Experiment Station and
Division of Farm Machinery, B.P.I.S.A.E., U.S.D.A.

In the production of many crops certain cultural treatments such as dusting, spraying and cultivating are necessary. Power equipment is generally used, and in some cases the operations are continued until the crop is mature. Unless provision is made for lifting the vines of certain crops they will be seriously injured by the wheels of the implements used and yields accordingly reduced.

In 1947 a set of vine lifters was built to fit a tractor in use at the Michigan Muck Experimental Farm. Although they were built for one specific make of tractor, it is thought that the design could be adapted to wheel tractors in general.[1] For this reason drawings with overall dimensions of the units are shown rather than detailed plans.

The contour and shape of the lifter is shown by the general view in Fig. 1.[2] The frameworks for the front and rear lifters are shown by Figs. 2 and 3. These drawings are presented to illustrate the mode of attachment and general overall measurement associated with these units.

The method of attachment of the lifter to the front wheel is shown by Figs. 4 and 5. The lifter is attached to the front wheel by a shaft welded to the inside of the spindle assembly and by a spider that fastens to the rim bolts. The axes of bearings A and B as shown in Fig. 2 are concentric.

The outside pivot for the rear lifter is illustrated by Fig. 6. For this specific mounting, a square plate was welded to the rivets in the wheel hub. In order to prevent damage to the wheel from overheating, this plate was first tack-welded with an electric arc welder. Additional welding at intervals was done until the plate was securely fastened. The pivot plate is bolted to this plate and can be readily removed

[1]Detailed working drawings are not available for the vine lifters because each make and model of tractor would require some modification in the design.

[2]These vine lifters were built by Paul Good, Mechanic, Michigan Muck Experimental Farm, and L. B. Vaughn, Buildings and Utilities Department, Michigan State College.

ARTICLE 31-52

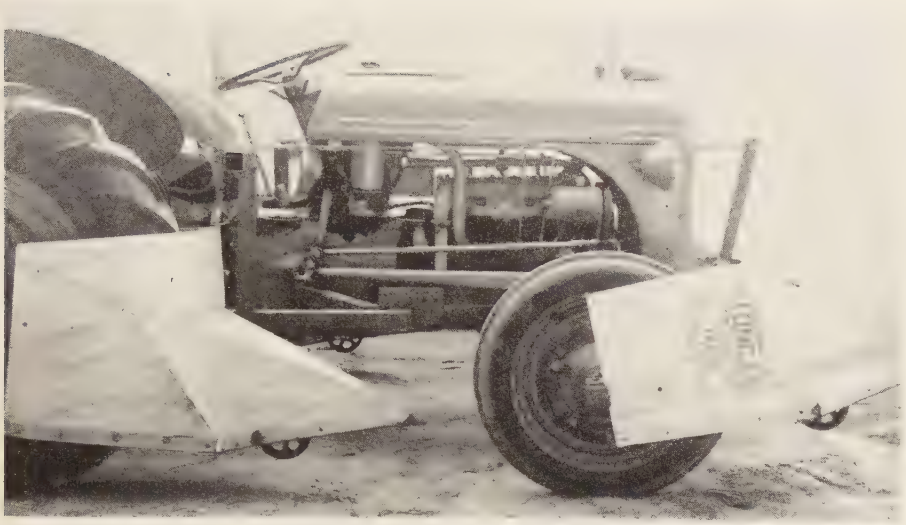

Fig. 1. General view of vine lifters.

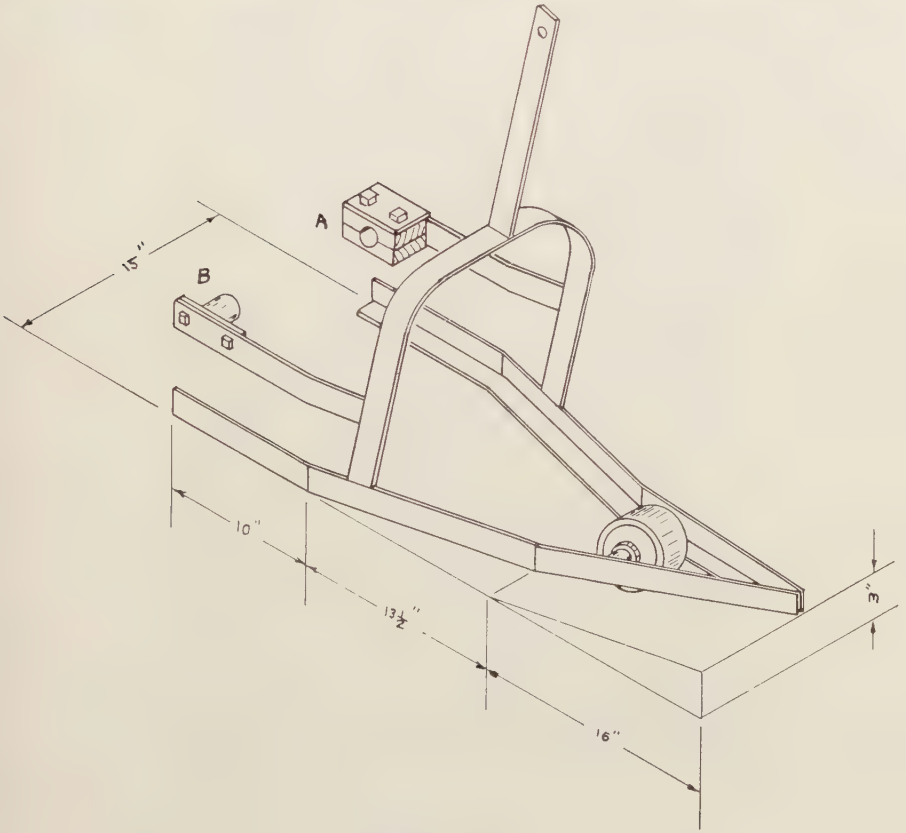

Fig. 2. Framework for left front lifter unit.

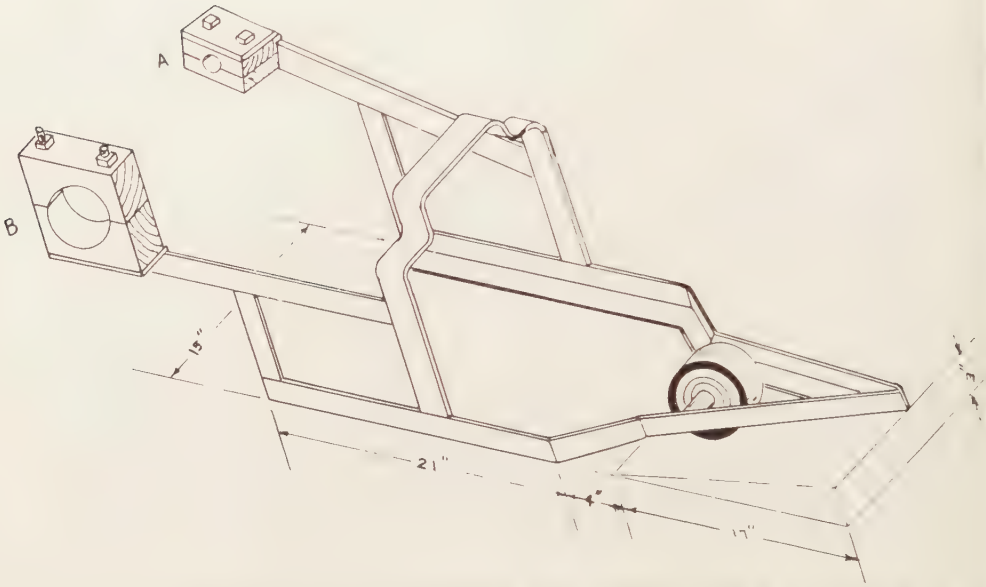

Fig. 3. Framework for left rear lifter unit. Outside pivot A is attached to the rear wheel as shown in Fig. 6. Inside pivot B is attached as shown in Fig. 7.

Fig. 4. Method of attachment of the front lifters to the outside pivot on the front wheel.

Fig. 5. Inside pivot for the front lifter.

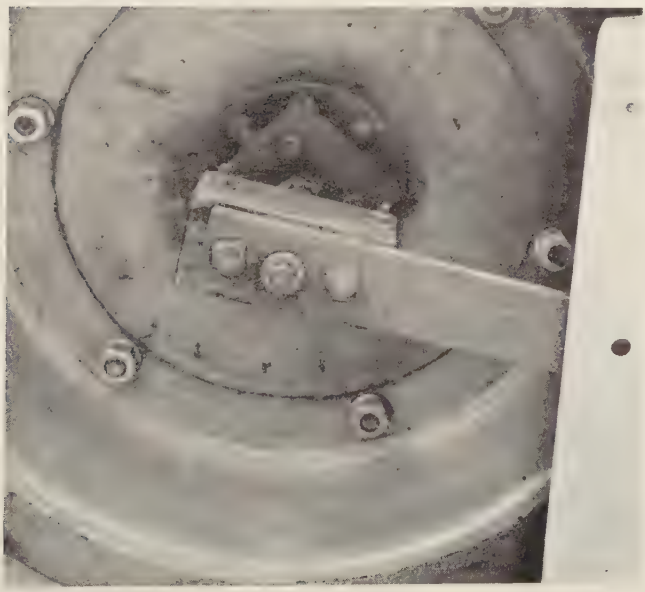

Fig. 6. The method of attachment of rear lifter to the outside pivot on the back wheel.

Fig. 7. Attachment of inside pivot bearing of rear lifter to axle housing.

when the lifters are not in use. The inside attachment for the rear lifter is shown by Fig. 7 and consists of a split-oak pillow-block, loosely fitted to the axle housing.

The framework is covered by 18-gage galvanized sheet iron, and a heavier metal tip protects the sheet metal from damage at the point

As illustrated in Figs. 2 and 3 small 6-inch, flat-rim wheels are used to carry part of the weight of the lifter when in operating position. These wheels also function as gage wheels to compensate for irregularities in the ground surface. However, it is believed that an adjustable shoe could be satisfactorily substituted for these wheels thus simplifying the construction.

The lifters are manually raised and lowered by chains attached to the lifter frame. A lever assembly could easily be built for this purpose. These lifters can be quickly attached and dismounted and have been found satisfactory on muck soils for several crops including onions and potatoes (Figs. 8 and 9).

In dusting or spraying crops, such as potatoes, that produce rank vine growth, injury to the crop from these operations will be materially reduced if the vines are trained by performing each subsequent operation in the same direction of the row.

Fig. 8. Dusting onions.

Fig. 9. Dusting potatoes.

TESTS OF REPELLENTS FOR PROTECTING GARDENS AGAINST COTTONTAIL RABBITS

By DON W. HAYNE
SECTION OF ZOOLOGY

COTTONTAIL RABBITS[1] can be an annoying pest in home gardens. Damage consists of the rabbits eating various young vegetable plants, especially peas, beets, green beans, and edible soybeans. Certain annuals and perennials of flower gardens are also consumed. In small gardens the entire crop may be taken, but as gardens cover larger areas, the damage becomes less severe, compared with the total crop. In commercial vegetable plantings the problem seems to disappear. Probably about the same number of rabbits feed in a large garden as would attack a small garden in the same location, since the numbers of these animals seem to be determined by many complex local factors.

Gardens may be protected by fencing with poultry netting 12 or 18 inches high. Rabbits do not seem to pass such fences in search of food, even though they would be able to jump such a barrier with ease. It is not necessary to bury the lower edge of a fence, providing that no openings are left at the bottom. Small stakes, fastened at frequent intervals to the lower wire, are useful in drawing it down to the ground level.

Reduction of the local population by live-trapping or by shooting is often suggested as a method of reducing damage. Cottontails do not enter traps readily during warm weather, and while they may be captured by using many traps, such a procedure is not practical for a gardener. As Pirnie (7) has shown, heavy hunting during the open season may not markedly reduce local numbers during the spring and summer. Further, cottontail damage to gardens frequently occurs in undeveloped suburban areas where city ordinances may forbid shooting.

[1] *Sylvilagus floridanus mearnsii* (Allen).

ARTICLE 31-53

Repellents offer another method of reducing damage to gardens. The purpose of a repellent is to make the protected plant less desirable to rabbits. Rabbits eat a diet composed of a very large number of different plants (4, 5). Certain plants are much preferred to others, and unfortunately this preferred list includes vegetables and flowers which we also prize. A good repellent will remove these plants from the rabbits' list of preferences but not interfere with our own use of the same plants. Then, rabbits may gather their food from the wild plants, without disturbing the garden, for garden vegetables seem to make up only a minute proportion of the normal diet of cottontails. There are a few recommendations in print concerning repellents for use in gardens (1, 2, 6).

PEN AND FIELD EXPERIMENTS

The present paper is a report on tests of repellents carried out from 1941 through 1943, and again in 1946. All tests relate only to cottontail rabbits. Five pen tests, involving 26 rabbits, were carried out, with one test in 1941, one in 1942, two in 1943, and one in 1946. Usable data were also obtained in six field tests. Of the 10 additional field trials where no usable data were obtained, 7 failed as experiments because all damage by rabbits ceased after the treatments were applied, and not even the untreated plants were eaten by rabbits during the experiment.

Tests of effectiveness of repellents are of two kinds, those carried out in pens with confined rabbits, and field tests carried out under natural conditions. Each kind of test has its own advantages (3). Pen tests seem necessary in order to have nearly uniform experimental conditions, and to make tests severe enough to force animals to distinguish between repellents. Field trials, however, must be the final test of whether a repellent is effective and practical.

The pen tests referred to here were carried out by raising string bean or cabbage plants in flats or in tin cans, and then placing these plants, treated, in outdoor pens with the rabbits. In most pen tests, several separately caged rabbits were tested at the same time, in order to study individual differences in preference.

Field tests were carried out either by planting a number of small plots of string beans or soybeans especially for the trial, or by treating vegetable plants already growing in gardens where damage was taking

place. In either type of experiment, a record was kept of the numbers of plants consumed during the following days.

As an example of the difference between pen tests and those in the field, the results observed following use of moth balls (naphthalene) may be cited. In a field experiment at the Kellogg Station near Augusta, Michigan, in September 1946, edible soybeans had been planted in 49 small plots. Owing to various accidents, including drought and insect attacks, only 49 plants with 129 leaves, growing on 21 plots, were usable. These plots were divided into four groups, and the plants treated with three materials: a spray of nicotine bentonite, a dust of tobacco dust and flour, and moth balls, 5 per plot. The plants of the fourth group were left untreated. Over a period of almost 2 weeks, the 33 leaves on the 6 untreated plots were reduced to 8 leaves, presumably by rabbits. At the same time, the 22 leaves of the 5 plots with moth balls were reduced only to 20 leaves. The plots with the other two repellents, considered together, lost 5 leaves out of 74. It would seem that moth balls furnished adequate protection in this test.

In contrast to this observation, data from another field test and from a pen test indicate that moth balls were barely to be distinguished

Fig. 1. Flats of treated string beans and cabbage plants were placed in outdoor pens containing rabbits.

from no treatment at all. It seems, therefore, that in the first field experiment the test conditions were so mild that the minor effect of the moth balls was sufficient to protect the plants. Where rabbits required more effective discouragement, moth balls were of little use. The same minor protective quality may probably be expected of most of the materials which are listed here as of little or no effectiveness.

DIFFERENCES BETWEEN RABBITS

Individual differences among rabbits in their dietary preferences are probably important as one of the reasons for conflicting reports from use of repellents (3). That such differences among individuals do exist was apparent in certain of the pen tests of this study, and the problem has been further investigated in relation to the tree-bark diet of rabbits in winter. Unpublished data of this last study reveal not only individual differences, but also differences between rabbits of one area and those of another. It is not known just how important these geographical variations in food preference may be, but their existence makes impossible any universal recommendation of repellents on the basis of local tests.

In support of the possible usefulness of the materials which are listed below as most effective, is the fact that the greatest individual differences in preference seem to occur in tests of repellents of only moderate protective ability. Further, materials listed in Group I have seemed superior in several pen tests and in field tests at three localities in Michigan (East Lansing, Ann Arbor, and Augusta).

MIXTURES TESTED

The various materials tested are classified here into three groups, according to the relative protective ability observed in the tests. The lists in the present paper are not equivalent to those lists which were published in a former paper (3), relating to repellents useful in protecting trees in winter. The two types of repellents present different problems, and the materials used cannot be compared directly.

In the following lists of materials, the figures following the ingredients show the proportional parts used, by weight, except where some unit of volume is specified. Teaspoon and tablespoon measurements are all level. When a test material was to be applied as a dust, the plants were sprayed lightly with water before dusting.

Several commercial preparations have been tested and are listed according to the results observed. In justice it must be pointed out that none of the manufacturers of these materials recommend their products as rabbit repellents. Inclusion of a brand name does not constitute an endorsement of that product.

GROUP I

The following materials have proven the most effective of those tested, and have shown good protective ability both in pen tests and in field trials. No deleterious effects have been noted following use of these materials with green beans, although no tests of this question have been made.

Nicotine sulfate, 40 percent, ½ teaspoon, water 1 quart, used as a spray. (Black Leaf 40, of Tobacco Biproducts and Chemical Corp., Louisville, Ky.)
Nicotine bentonite, 2 teaspoons, water 1 quart, used as a spray. (Black Leaf 155, of Tobacco Biproducts and Chemical Corp., Louisville, Ky.)
Tobacco Dust. Used as a dust, it is equal in effectiveness to the two nicotine preparations when freshly applied, and superior to anything else after an exposure of several days. Addition of 5 percent flour is said to hold tobacco dust on plants better, but one test indicates that this may slightly reduce the effectiveness against rabbits. Plants should be sprayed lightly with water before dusting.

Red pepper 1, wheat flour 1, used as a dust. Use of a lesser proportion of red pepper, or substitution of black pepper, decreases the effectiveness.

GROUP II

The materials listed in this group have proven in the tests to be less effective than those of Group I, but still clearly provided better protection than did no treatment.

Bordeaux spray: copper sulfate 1 ounce, hydrated lime 1½ ounces, water 1 gallon. In pen tests this ranked in effectiveness with Group I when fresh, but seemed to lose effectiveness after a few days. Some instances of damage to plant tissue may have been caused by this spray.
Bordeaux dust. In pen tests this dust was equal in protective ability to bordeaux spray, and no observations were made concerning the lasting power.

Red pepper 1, wheat flour 5. Used as a dust this was only slightly more effective than flour alone.

Black pepper 1, wheat flour 1, used as a dust.
Wettable sulfur, 10 tablespoons, water 1 quart, applied as a very heavy coating. A lighter coating was less effective.

Rosin dust, consisting of powdered rosin, stayed on the plants poorly.
Rosin emulsion, 2 tablespoons, water 1 quart, used as a spray (from Dr. E. J. Miller, Experiment Station Chemist, Michigan State College).
Flour. Ordinary wheat flour, used as a dust, seems to fall at the lower level of this group.

GROUP III

The protection furnished by these materials was little or no better than no treatment. A few seemed effective in field tests, but not effective in pen tests.

Alum, 2 tablespoons, wheat flour 1 quart, used as a dust.
Lead arsenate, 2¼ teaspoons, water 1 quart, used as a spray. Severe burning of plant foliage resulted from its use.
Gypsum, powdered, used as a dust.
Lime, hydrated, used as a dust.
Lime, hydrated, 2½ tablespoons, water 1 quart, used as a spray.
Sulfur, powdered, used as a dust.
Wettable sulfur, 1½ tablespoons, water 1 quart, used as a spray.
Naphthalene "moth balls," placed on the ground under plants or set in the midst of the leaves on the ends of wires.
Epsom salts, 3 ounces, water 1 gallon, used as a spray.
Lysol, 1 teaspoon, water 1 gallon, used as a spray. (Lehn and Fink Products Co., Bloomfield, N. J.)
Evergreen Spray, 1 teaspoon, water 1 quart, used as a spray. (McLaughlin Gormley King Co., Minneapolis, Minn.)
Cuprous oxide, ⅓ teaspoon, water 1 quart, used as a spray. (Cuprocide, of Rohm and Haas Co., Inc., Philadelphia, Pa.)
Scram Dog Repellent, 1½ tablespoons, water 1 quart, used as a spray. (California Spray-Chemical Corp., Richmond, Calif.)
A fixed copper, 1 tablespoon, water 1 quart, used as a spray. (Cupro-K, of Rohm and Haas Co., Inc., Philadelphia, Pa.)

SUMMARY

The comparative ability to protect gardens from cottontail rabbits, *Sylvilagus floridanus mearnsii,* is reported for 26 materials as observed in pen and field trials. Highest ranking in protective ability are preparations of nicotine, tobacco dust, and a mixture of red pepper and flour, with tobacco dust showing superior lasting qualities. All of these materials are subject to being washed off in a rain.

Any recommendation of a repellent must be made subject to local field testing, because of probable geographical differences in certain food preferences of cottontail rabbits.

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A MODIFIED ASSOCIATION—BABCOCK TEST FOR HOMOGENIZED MILK

By J. ROBERT BRUNNER, G. M. TROUT, and P. S. LUCAS
SECTION OF DAIRY

DIFFICULTY ENCOUNTERED in testing homogenized milk by the standard Babcock procedure has stimulated the introduction of numerous modifications of the method. Trout and Lucas (1945), comparing 12 modifications of the Babcock method for testing homogenized milk, reported that most satisfactory tests were obtained when the full amount of normal-strength sulfuric acid was introduced in at least three portions, was centrifuged, and then shaken following the addition of water.

From these studies, Lucas and Trout (1947) introduced another modification of the Babcock test, the technique of which involved a) tempering the acid and milk to 70°F.; b) using at least 17.5 ml. of sulfuric acid with sp. gr. of 1.83 to 1.835; c) adding the acid in three portions, the first consisting of approximately one-half of the acid; and d) prolonging the agitation of the acid-milk mixture prior to centrifuging. While this method yielded results on homogenized milk only 0.018 percent lower than that of nonhomogenized milk, routine laboratory use of the method showed that its success depended to a large extent upon the technique and experience of the operator.

To determine the applicability of selected methods for testing homogenized milk, Trout and Lucas (1947) made a comparative study of the Gerber, Minnesota, Pennsylvania, and Mojonnier methods. They reported satisfactory tests of homogenized milk by the Mojonnier and Gerber methods. However, for routine testing of milk the Mojonnier procedure is not so desirable as tests utilizing Babcock glassware. The Gerber method was found to be quite satisfactory for testing homogenized milk. The chief limitation to the use of the Gerber method in this country would be the necessity of introducing a completely new testing procedure requiring special testing equipment and training into the industry, as well as the long procedure of securing the

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recognition of the test as a legal method by the several state and national legislatures.

Consequently, it was felt that a rapid test utilizing the present Babcock testing equipment but depending to a lesser degree on the personal factor would be desirable. To this end further studies were made.

EXPERIMENTAL

Samples of pasteurized milk homogenized at 2500 pounds pressure and held at 40°F. for 12 hours were tested by various methods. Procedure, simplicity, appearance of the fat column, and accuracy of the test as compared with Mojonnier determinations were factors considered. A modification of the Association (1933) test for buttermilk produced encouraging results. This procedure, in addition to utilizing the standard Babcock testing equipment found in every milk plant, requires but one reagent other than the normal-strength, commercial sulphuric acid. The second reagent, normal butyl alcohol, may be obtained from most dairy or chemical supply houses.

Method—The testing procedure as finally adopted was as follows:

a. Temper the sample of homogenized milk to be tested and the sulfuric acid to 60°F.

b. Pipette 17.5 ml. (18 grams) of the tempered sample into an eight-percent milk test bottle. Add 3 ml. of normal butyl alcohol and 14 to 16 ml. of acid. Shake for approximately one minute.

c. Centrifuge test and add water as in standard Babcock procedure.

d. Add two or three drops of glymol to the top of the fat column just prior to reading the test. With the aid of dividers, read from the glymol-fat interface to the base of the lower meniscus.

The procedure as outlined requires no special precautions or manipulations other than those generally observed in the standard Babcock procedure. Ten samples of homogenized milk were tested in triplicate by the above-mentioned procedure, and the averages of these tests were compared with averaged duplicate Mojonnier determinations (Table I).

TABLE 1—*Comparison of modified Association-Babcock and Mojonnier tests of homogenized milk*

Sample number	Modified Association-Babcock test				Mojonnier test (average of duplicates)	Deviation from Mojonnier test
	Trial 1	Trial 2	Trial 3	Average		
	Percent	Percent	Percent	Percent	Percent	Percent
1	3.30	3.40	3.30	3.33	3.3105	+.0195
2	3.60	3.60	3.60	3.60	3.5940	+.0056
3	3.60	3.60	3.70	3.63	3.6705	−.0405
4	3.60	3.50	3.60	3.57	3.5789	−.0089
5	3.90	3.90	3.90	3.90	3.8921	+.0079
6	4.00	4.00	4.00	4.00	4.0111	−.0110
7	4.10	4.00	4.00	4.03	4.0130	+.0170
8	4.10	4.10	4.10	4.10	4.0820	+.0178
9	4.00	4.00	4.10	4.10	3.9500	+.0500
10	5.40	5.50	5.40	5.43	5.4202	+.0098
					Average deviation.....	+.0089

DISCUSSION

While too little acid or too low sample temperatures result in the appearance of nondigested curd formation at the base of the fat column, too much acid or excessively high sample temperatures cause charring and the appearance of charred particles throughout the fat column. Although these characteristic defects were sometimes obtained they did not represent a serious problem if ordinary precautions were observed. In fact, it was quite difficult to produce these defects experimentally. Nevertheless, some variation in operational temperatures may be tolerated without appreciably affecting the reliability of the test.

Consistently clear fat columns, free from curdy deposits or charred material, were obtained when 15 ml. of acid at room temperature was added to milk samples at 50° to 55°F. Equally satisfactory tests were obtained by adding 14 to 16 ml. of acid at 60°F. to milk samples tempered to the same temperature.

During the course of experimentation it was observed that the use of less than 2 ml. of normal butyl alcohol was conducive to the formation of a curdy layer at the base of the fat column. When this defect occurred, the fat determination was generally below that obtained by the Mojonnier method. The curd layer was not eliminated by the use of larger quantities of acid, which had in effect a greater tendency to burn the sample, but by the use of more butyl alcohol in making the test.

On the other hand, if normal butyl alcohol in excess of a 3-ml. portion were added these defects were minimized, but the results were

about one-tenth percent higher than those by the Mojonnier method. The optimum quantity of normal butyl alcohol required to produce consistently clear, accurate fat columns with 14 to 16 ml. of acid at 60°F. was 3 ml.

The addition of glymol prior to the reading of the fat columns seems to be an integral part of the test proposed in this study. Otherwise, the test would yield results from 0.10 to 0.15 percent higher than those obtained by the Mojonnier method.

SUMMARY

The Association test, modified for testing homogenized milk, has been used effectively. The modified Association test consists in a) tempering the milk and reagents to 60°F.; b) adding 3 ml. of normal butyl alcohol and 14 to 16 ml. of commercial sulfuric acid to 17.5 ml. of milk; and c) using glymol in reading the fat columns. The results obtained by this procedure on ten samples of homogenized milk were clear, free of curdy material at the base of the fat column, and averaged within ±0.05 percent of the results obtained by the Mojonnier method, the average deviation being +0.009 percent.

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CONSUMER REACTION TO BOTTLED FRESH CONCENTRATED MILK

By G. M. TROUT and G. G. QUACKENBUSH
Sections of Dairy and Agricultural Economics

Considerable publicity has been given lately to methods of processing and distributing milk, which might mislead the consumer to believe that immediate changes in the present system of assembling, processing, bottling and distributing fresh milk are in the offing (1).

One of these methods developed in Indiana by Stambaugh and Graves consisted, in brief, in homogenizing the warm milk as it was assembled in a vat directly from the cows, pasteurizing the milk at 190° F. for 1 second in a jacketed, steam cylinder, fitted with a spiral core, canning and sealing it in a nitrogen atmosphere and, lastly, sterilizing the milk. Another method first introduced by Meredith and Stoltz (2) of Ohio and recently studied in Michigan consisted in concentrating the milk under vacuum, homogenizing, pasteurizing, cooling, bottling, and distributing it the same as is done with regular milk.

The Indiana method involves processing the milk directly from the cow to the can. The product is not concentrated; hence, the product remains as normal milk in composition. On the other hand, the Ohio method involves vaporizing off much of the water under vacuum, thus reducing the bulk for more economical distribution. The milk may be reconstituted in the home for beverage purposes merely by the addition of water. A brief review of the Ohio process and its acceptance by the consumer is of interest.

During the depression years of the early 'thirties Meredith and Stoltz (2) introduced bottled concentrated milk in order to make available a lower priced fresh milk for the consumer. Observations on consumer reaction to the reconstituted product, as well as numerous studies on the effects of the process on various properties of the milk, indicated that the product had much merit. Nevertheless, the product never "caught on". This may have been due in large part to the fact

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that the product was ahead of its time. Since then, some changes have been made in milk distribution which might make a bottled, concentrated milk more acceptable. For example, every-other-day delivery has crowded the consumers' refrigerator despite the advent of the square bottle. Also, store sales in some metropolitan areas have far exceeded home delivery sales (3). A bottled concentrated product would require less refrigerator space, and less weight would be involved in carrying home concentrated milk from the stores. Already paper containers have reduced somewhat the weight of the milk load carried from the stores.

In view of these trends and the fact that normal milk is bulky because of its high water content, thus adding to the processing and distributing costs, it seemed desirable to make further studies on consumer reaction to bottled fresh concentrated milk. This paper is a progress report on the data obtained to date.

PROCEDURE

Fresh whole milk previously heated to 150° to 160° F., was concentrated in a 42-inch stainless steel vacuum pan at ratios of 2:1, 3:1, and 4:1. Following concentration the milk was holder-pasteurized, homogenized at various pressures, cooled and bottled. Quiescent-storage, fat-rising tests were made at 48 hours to ascertain the efficiency of homogenization. Flavor examinations were made in the laboratory on the reconstituted product, using for reconstitution waters obtained from three widely separated sections of Michigan. Consumer reaction was obtained through questionnaires to consumers who were furnished samples of the series under study.

RESULTS

EFFECT OF CONCENTRATING AND RECONSTITUTING ON THE FLAVOR OF THE MILK

Milk concentrated at various ratios and reconstituted to its original composition was judged by experienced milk judges as well as by consumers. The judgments of the experienced judges are recorded in Tables 1 and 2; those of consumers are presented in another section. In some of the trials the experienced milk judge was inclined to criticize the flavor of the concentrated-reconstituted milk. When "excellent" flavor milk was so processed the judges placed the concentrated milk, so far as flavor was concerned, in the class of "good" or "fair"

milk. As the ratio of concentration increased, which necessitated greater additions of water to restore it to its original composition, the flavor was less desirable. However, the flavor of the reconstituted milk was not objectionable although generally the judges criticized it as "flat" or "cooked", the fine, excellent flavor having been impaired in the process. This flavor criticism was not greater than sometimes is experienced with commercially pasteurized milk.

TABLE 1—*Flavor of milk concentrated at various ratios and reconstituted to its original composition by the addition of water*

Homogenization pressure (lbs./sq. in.)	Flavor score* of the			
	Original milk	Reconstituted milk which had been concentrated at the ratio of		
		2:1	3:1	4:1
0	23	21½	20½	19
2500	23	21½	20½	19
4000	23	21½	20½	18½

*Key: 23, excellent; no criticism
21–23, good
18–21, fair

TABLE 2—*Effect upon the flavor when concentrated milk was reconstituted with water obtained from widely separated areas of Michigan*

Homogenization pressure (Lb./sq. in.)	Ratio of concentration	The flavor of the reconstituted-concentrated milk which was reconstituted by the addition of water from area		
		A	B	C
0	None			
2500	None			
4000	None			
0	2:1	No criticism	No criticism	Salty
2500	2:1	Sl. cooked	No criticism	Sl. salty
4000	2:1	No criticism	No criticism	Sl. salty
0	3:1	No criticism	No criticism	Salty
2500	3:1	No criticism	No criticism	Salty
4000	3:1	Watery	No criticism	Salty

The source of the water used in reconstituting the milk has some effect on the flavor of the reconstituted product (Table 2). When drinking water from one area, designated as area C, was used in reconstituting the milk, the flavor of the milk was invariably criticized as being salty. The original water also tasted of salt, however. No off flavors were noted in the reconstituted milk when water from other areas was used.

THE ROLE OF HOMOGENIZATION IN PROCESSING CONCENTRATED MILK INTENDED FOR BOTTLING AND RECONSTITUTING

The effects of concentration and homogenization upon fat rising in the reconstituted milk are shown in Table 3. As the ratio of concentration increases, the extent of fat rising decreases as indicated by the percentage difference of fat between the upper 100 ml. and the remainder of a quart after 48 hours of quiescent storage. This might well be expected since higher concentrations require longer exposures to the heat and agitation incident to the process. Nevertheless, sufficient fat rises in the reconstituted milk regardless of the ratio of concentration to yield a creamy concentration on the surface. The creaming ability of the milk is so impaired, however, by the process that normal creaming does not occur. Hence, adequate homogenization would seem to be essential in producing concentrated milk for bottling purposes. Data indicate that pressures of 2,000 to 2,500 pounds per square inch would seem to be adequate. The data reported in Table 3 were obtained on milk homogenized prior to condensation. Data obtained on other trials in which the milk was homogenized after concentration indicate that pressures of 2,000 to 3,000 pounds were sufficient to keep the percentage difference in fat between the upper and lower portions to 5 percent or below.

TABLE 3—*Influence of concentration upon the extent of fat rising in the reconstituted milk*

Homogenization pressure (Lb./sq. in.)	Percentage difference of fat between the upper 100 ml. and the remainder of a quart of the reconstituted milk after 48 hours of quiescent storage when the ratio of concentration was			
	None	2:1	3:1	4:1
	percent	percent	percent	percent
0	239.72	84.57	60.27	43.62
2500	7.75	−0.24	4.40	1.80
4000	2.5	−2.92	7.8	0.79

TECHNICAL PROBLEMS IN PROCESSING AND BOTTLING CONCENTRATED MILK

The technique of producing concentrated milk for bottling is essentially the same as that for evaporated milk. Both involve vacuum condensation and adequate homogenization. However, since the bottled product is not sterilized, those techniques to prevent curdling of milk under pressure sterilization of evaporated milk are not a part of the processing of concentrated milk for bottling purposes. The forewarming temperature is purposely kept low, between 150° and 160° F., in

order to prevent so far as possible a cooked flavor. Nevertheless, in our present method of condensing even under high vacuum, steam at low pressure is used as the heating medium. The temperatures of the steam vary with the pressure and are always above 212°F. Such temperatures applied to microscopic films of milk repeatedly during the process inevitably cause a heated, "condensed-milk" taste despite the low indicating thermometer temperature (135° to 140°F.) of the milk itself during evaporation. Thus, under this system of evaporation, the fresh, nonsterilized milk will have the cooked flavor, more or less pronounced.

With experience, concentrating the milk to a predetermined ratio and desired composition may be done within limits. However, exact composition is attained by final testing and standardization after the concentrate is drawn from the pan. Homogenization, pasteurization, cooling and packaging then follow.

Securing low bacteria counts and negative phosphatase tests presented no difficulties. Standard plate counts of the concentrated product ranged from 500 to 13,000. Phosphatase tests were all negative. Nevertheless, coliform tests indicated post-pasteurization contamination. This is not surprising considering the small quantity of each batch, about 25 gallons, actually packaged, which involved manual operation, in part.

CONSUMER REACTION TO THE FLAVOR OF FRESH CONCENTRATED MILK

Bottles of milk concentrated at the ratio of 2:1 and 3:1 were furnished many families and individuals, along with a questionnaire asking for certain specific information. Specific directions on reconstituting the milk were given. The following questions concerning flavor were asked:

a) *Do you see any difference in the taste of the reconstituted milk as compared with that of the milk you have been using?*

A total of 123 questionnaires were returned; 31, 50 and 42 being received from trials 1, 2 and 3 respectively. Not all responding to the questionnaire answered all the questions asked. The percentage distribution of the responses are presented in Table 4. These were recorded as three trials. Trial 1 represents a composite of responses on three different lots of milk. Samples from these lots were furnished to older individuals and families wherein the feeding of chil-

dren likely did not aid in the detection of differences between the reconstituted-concentrated milk and the regular milk. Responses in trials 2 and 3 were from two individual lots of milk. "GI" families and younger people, as well as many older people, were furnished samples. Data indicate that an overwhelming majority of those using the milk could detect differences between the reconstituted-concentrated milk and the regular milk (Table 4). However, this high percentage of detection of flavor difference does not infer that the flavor noted was objectionable in any way. In fact, data indicate that the flavor was not objectionable although a difference in flavor was noted (Table 4).

TABLE 4—*Consumer response concerning possible flavor differences between reconstituted-concentrated milk and regular pasteurized milk*

Response as to flavor	Percentage distribution of responses in		
	Trial 1	Trial 2	Trial 3
Difference in flavor	percent	percent	percent
Yes	69	82	90
No	31	18	10
Flavor objectionable			
Yes	19	22	23
No	81	78	64*

*13 percent made no response.

b) *Was the flavor objectionable?*

Those noting differences between the flavor of the reconstituted-concentrated milk and regular milk were asked to describe the flavor of the reconstituted product. The following responses were given:

Seemed somewhat heavier than normal milk.
Tastes more like condensed milk.
Possibility of taste from water used to dilute.
A lingering taste of condensed milk, not serious.
Slight cooked.
Some different flavor as if cooked.
Sweeter.
Sweeter, like caramel, smoother.
Little more bland and slightly sweeter.
Tastes boiled.
Sweeter and smoother.
Like regular homogenized milk.
Richer, definitely sweeter.
Too creamy, tastes like milk made from dry powdered milk.
Cooked, salty.
Salty; far superior to our regular milk.
Rich, smooth.

Some evidence of cooked flavor.
Tastes like raw milk.
A sickening, heavy sweet taste. Also cooked.
Cooked.
Slightly thicker and rich flavor; seems sweeter.
Cooked, abnormally sweet.
Seems richer and slightly sweeter—like ice cream.
Creamy and a little richer; a slightly cooked flavor.
Only slightly cooked.
Slight sweet taste not apparent in raw milk.
Suggestion of condensed milk taste.
Slightly cooked but rather pleasing.
Dairy products flavor.
Caramel taste.
Chalky taste.
Tastes like evaporated milk.
Slightly burned taste.
Similar to cow's milk, like Jersey, maybe richer.
Slightly sweeter than ordinary milk.
Seems to have slightly condensed flavor.
Too rich tasting after one glass.
Soap taste.
Slight taste of being scalded.
A bland flavor.
A more distinct taste but not like evaporated milk.
A chalky taste.

A survey of this list of descriptions shows that the flavors associated with the heat of processing such as "cooked," "condensed," "boiled," "caramel," seem to predominate. Flavor terms such as "sweeter," and "richer," appear to follow closely.

CONSUMER PREFERENCE OF CONCENTRATION

In these studies the milk was concentrated 2:1, 3:1 and 4:1. The latter concentration was so viscous and involved the addition of so much water in reconstituting it to its original composition that further studies on it were discontinued. Thus, only concentrations of 2:1 and 3:1 were submitted for consumer reaction. Data did not seem to indicate any decided preference over one for the other; in trial 1 responses were tied; in trial 2 the concentration of 2:1 was preferred, whereas in trial 3 the 3:1 concentration was the choice. Considering the increased viscosity, adhesion to container, and amount of water to reconstitute it, the 3:1 concentration would seem to be too concentrated. However, approximately two-thirds of those responding to the questionnaire found no difficulty in reconstituting the milk, but did not specify which concentration.

Saving of refrigerator space—Since the product is concentrated less refrigerator space would be required than for storing an equivalent amount of regular milk. It seemed desirable to ascertain if the saving of refrigerator space would be of any value to the consumer. Obviously, it was. Responses in trials 2 and 3 (the question was not asked in trial 1) showed that 61.2 and 76.7 percent, respectively, considered the saving of refrigerator space valuable to them. A small percentage made no reply to this question.

CONSUMER REACTION TO POSSIBLE PURCHASE OF BOTTLED CONCENTRATED MILK IF IT WERE MADE AVAILABLE

Those having the opportunity of using the milk were asked if they felt honestly they would be interested in using it if it were made available. Responses indicated they would be interested in using the product, only if there were a saving of 3 cents per quart of milk equivalent (Table 5). A small percentage indicated they would not buy the product at all. Eighty-six and 87 percent, respectively, of those responding in Trials 2 and 3 to the question *"In your opinion has this milk any commercial possibilities?"* indicated they believed bottled concentrated

TABLE 5—*Reaction of the consumers who used fresh concentrated bottled milk towards buying it if it were made available*

Response	Percentage distribution of responses in		
	Trial 1	Trial 2	Trial 3
Interested in using the product			
Yes	—	66	82
No	—	28	18
Questionable	—	6	0
At the same price as milk equivalent?			
Yes	26	12	22
No	74	—	—
At the saving of 2 cents per quart of milk equivalent?			
Yes	52	24	25
No	48	—	—
At the saving of 3 cents per quart of milk equivalent?			
Yes	67	40*	53
No	33	—	—

*9 percent would not buy at all; 15 percent made no response.

milk had commercial possibilities (Data not included in Table 5). The remaining made no reply to the question. Yet, those indicating the product had commercial possibilities manifested, as shown by percentage distribution figures (Table 5) that a material saving per quart of whole milk equivalent had to be effected.

DISCUSSION

Bulk, and hence weight, has always been a factor in the economic distribution of milk. Nevertheless, dependable doorstep delivery of safe milk of good beverage quality has done much toward increasing and maintaining high levels of fresh milk consumption in the United States. That the percentage distribution of home-delivered milk will decrease and retail store sales will increase in metropolitan areas is inevitable. Already in some markets such shifts in distribution methods have occurred at a profound rate. Single-service containers, having less weight, have been a factor in the shift to store sales. Just what influence such packaged fresh concentrated milk would have on store sales and maintained milk consumption is highly speculative. The data reported herein furnish some evidence that, at a price, concentrated milk might be purchased and that although there may be a slight cooked flavor, the reconstituted milk had good beverage quality. Indications were noted also that the product might well be used without reconstitution in soups and as cream in coffee or on cereal.

While the product itself does have much merit it is not unthinkable that its introduction could be associated with embarrassing situations to the dairy industry. For instance, the health hazard of reconstituting milk in the home is not to be overlooked. Even sickness, traceable to milk, would have a depressing effect on milk consumption. The attitude of the health and regulatory officials must be considered also. Health regulations in many cities do not permit double pasteurization of milk. While the condensing process is not a pasteurization process it does involve a comparatively high heat treatment which may be construed as one form of pasteurization although not recognized as such. Actual pasteurization must follow the condensing, standardizing and homogenizing processes to assure a safe product. Furthermore, the psychological aspect of diluting milk with water is not conducive to the anticipation of milk drinking. It is believed that one of the factors responsible for the high level of milk consumption in the United States is the making available at all times by home delivery or through stores packaged, fresh, safe milk at a fair price.

Data obtained in the Ohio studies in 1935 show the cost of quantity concentration to be materially less than one cent per quart of whole milk equivalent. Thus the cost of concentration is not prohibitive. Savings on items such as container cost, especially if paper containers were used, closures, bottle washing and delivery might be effected. Nevertheless processing, packaging, and distribution of fresh concentrated milk does not lend itself to economies to the extent that prevail in the evaporated milk industry. It is believed, however, that some opportunities do exist for a reduction in the retail price of milk through concentration, provided there is sufficient volume to permit efficient use of evaporating equipment. Thus, while the introduction of fresh concentrated milk might make available to the consumer lower priced milk than that of standard bottled milk it remains to be seen if the reduction in price would be sufficient to stimulate increases in milk consumption. On the other hand, fresh concentrated milk produced in surplus areas for transportation and use in territories experiencing a shortage of milk would seem to offer great possibilities. Such milk thus might be a) bottled and distributed as a concentrate, b) reconstituted and bottled, and or c) reconstituted and mixed with the existing milk supply as an extender.

SUMMARY

Bottled fresh concentrated milk, concentrated at ratios of 2:1 and 3:1, homogenized and pasteurized, was furnished consumers in order to find out their reactions to the product.

The process of concentration itself was very similar to that employed in preparing evaporated milk for canning. Insofar as possible low temperatures in forewarming were used to keep the formation of heated flavors to a minimum. Nevertheless, the cooked type of flavor seemed to predominate in the reconstituted product.

Homogenization pressures of 2,000 to 2,500 pounds per square inch were adequate to maintain satisfactory homogeneity of the reconstituted product.

Little difficulty seemed to be encountered in reconstituting the product in the home. The type of water used was found to be a factor affecting the flavor of the reconstituted milk but was believed not to be a serious one.

As a rule, consumers noted a difference in flavor between the reconstituted milk and regular pasteurized milk, but the cooked flavor predominating was not objectionable to the majority of the consumers surveyed in the study. While most of the consumers were interested in the added refrigerator space afforded by using the concentrated product they were not interested in buying it regularly unless a saving of 2 or 3 cents per quart of milk equivalent could be effected. However, the greater percentage of consumers believed that bottled, fresh, concentrated milk had commercial possibilities.

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THE ACTION OF ACTIDIONE ON PLANT TISSUE AND UPON CERTAIN FUNGI

By JOHN R. VAUGHN, JOHN L. LOCKWOOD, G. S. RANDWA, and CHARLES HAMNER

Sections of Botany and Plant Pathology and Horticulture

A preliminary report on the use of actidione, an antibiotic, for the control of mildew on bean plants has been reported in the *Botanical Gazette* (1). It was found that where an aqueous solution of actidione at 10 p.p.m. was sprayed on bean plants affected by mildew, the grayish white patches on the upper surface of the leaves disappeared completely within 48 hours, indicating that the mycelium and the conidia of the fungus *Erysiphe polygoni* D. C. had been destroyed.

Since mildew is a problem on many plants grown in the greenhouse and in the field, it was decided to investigate the action of actidione on a wide variety of plants to see what possible toxic effect it might have on plant tissue and seeds. The fungal spectrum for other organisms which cause plant disorders was also investigated.

The actidione used in these experiments was obtained from the Upjohn Company, Kalamazoo, Michigan. It is an antibiotic material obtained from the cultures in which streptomycin-producing strains of *Streptomyces griseus* are cultivated (3, 4). The chemical structure has been determined and described (5).

EXPERIMENTAL

Seed germination was tested using peas (var. Shasta), radish (Scarlet Globe), wheat (American Banner) and beans (Red Kidney) as the test materials. The procedure was to soak the seeds in an aqueous solution of actidione for a period of 4 hours, and then plant the seeds in petri dishes in moist filter paper. In the case of radish and wheat, 50 seeds were planted per dish and replicated four times. When peas were used, 25 seeds were placed in each dish and the treatments were replicated four times. For comparison, seeds soaked

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in tap water for 4 hours were used as controls. The dishes containing the seeds were then placed on laboratory tables at room temperatures which remained constant at about 75° F. In order to determine reaction of the seeds to the treatments, germination records were taken daily.

Because of their large size, bean seeds were placed in soil under greenhouse conditions. In experimentation with actidione on peas, radish, and wheat seed, the seeds were soaked in concentrations of 1, 5, 10, 20, 50 and 100 p.p.m. of actidione.

With certified Red Kidney bean seeds the seeds were soaked in concentrations of actidione at ½, 1, and 10 p.p.m. for 4 hours. They were then planted in soil in flats. Fifty seeds were planted per flat and four flats used in each treatment, making a total of 200 seeds per treatment. The flats were placed on a bench and allowed to germinate under greenhouse conditions.

In addition, seeds of cucumber, cantaloupe, and spinach were soaked in strengths of 1, 5, 10, 20 and 100 p.p.m. of actidione for one-half hour. These were planted in replicated rows in flats and stand counts taken at intervals.

DISCUSSION OF RESULTS ON SEEDS

The same concentration of actidione was used with radish and wheat seed as with peas. The inhibition in germination of radish seeds was much more pronounced than with peas. Almost complete inhibition occurred at 100 p.p.m. while 28 percent occurred at 50 p.p.m. Even though very little decrease in eventual germination occurred either at 1 or 5 p.p.m., there was considerable delay in germination (Fig. 1).

It should be noted that the pea seed during the 4-hour soaking period did not absorb much water and as a result possibly much less actidione was absorbed in comparison to radish, wheat, and bean seeds which took up water freely during the soaking period. The results, however, show considerable inhibition in germination, with actidione only about 38-percent germination being noted at 100 p.p.m. (Fig. 2). In general, the inhibition in germination was in proportion to the concentration of actidione.

A similar inhibition in germination with actidione was noted with wheat seed except that a concentration of either 10 or 20 p.p.m. resulted in almost the same degree of inhibition. It should be noted

that almost complete inhibition of wheat seed germination occurred at 100 p.p.m. indicating that the reaction of wheat seed to actidione was much more pronounced than to a similar concentration of 2,4-D (2) (Fig. 3).

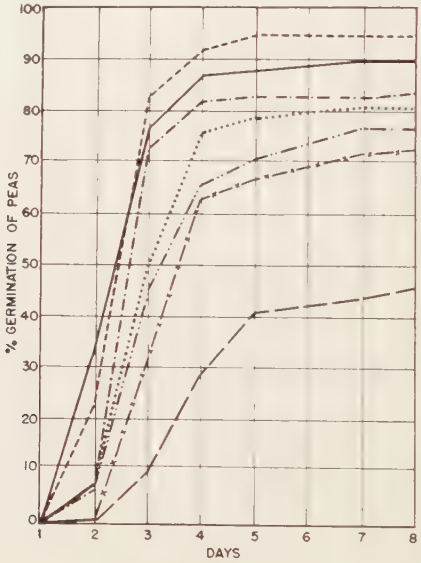

Fig. 1.

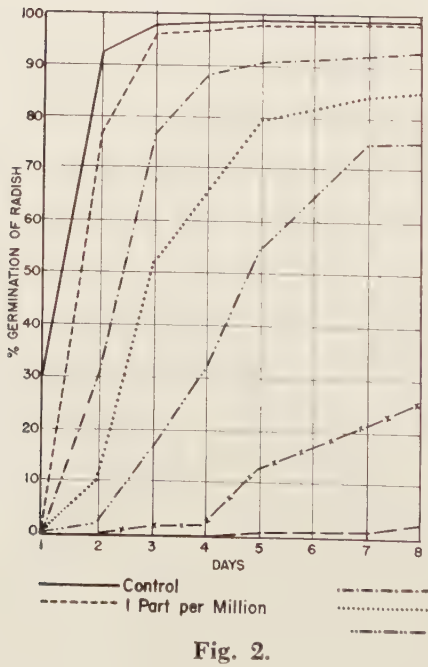

Fig. 2.

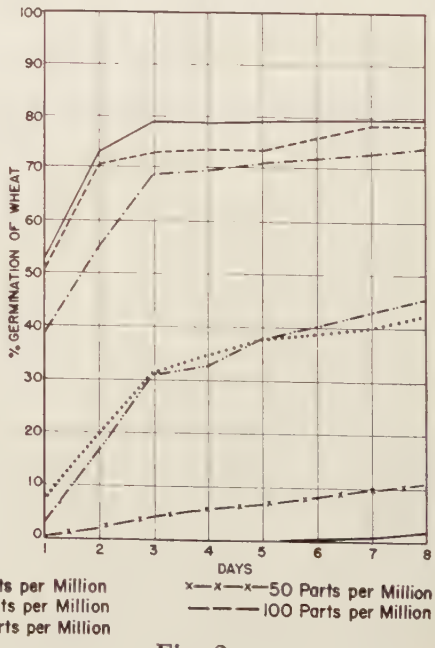

Fig. 3.

Results show that about a 50-percent decrease in germination occurred when pea seeds were soaked in an aqueous solution of actidione at 10 p.p.m. (Fig. 1).

Because of its possible use as a soil fungicide, actidione was applied to the soil at concentrations of 1, 5, and 10 p.p.m. In each treatment 50 Red Kidney bean seeds were planted per flat and replicated four times.

When actidione was applied to the soil at 10 p.p.m., considerable inhibition of germination occurred. The degree of germination of beans in soil treated with 10 p.p.m. of actidione was 17.4 percent as compared to 46.7 for the controls (Fig. 2).

The one-half hour soak of seeds of cantaloupe, spinch, and cucumber gave absolutely no evidence of inhibition of growth or decrease of germination when compared with non-treated controls. Not even the highest concentration used (100 p.p.m.) was different in percentage of germination of seeds or vigor of seedling plants.

TREATMENT OF ROSES

With the application of new insecticides in aerosol form in many commercial greenhouses, it appears that powdery mildew is becoming more of a problem in many plants and its control by chemical methods has not been satisfactory. It has also been reported by many growers that sulfur and parathion are not compatable and, hence, cannot be used together in a spray program. Since parathion will undoubtedly be used by most growers for insect control, it would seem desirable to explore other methods than sulfur for mildew control.

Several trials with actidione on roses were run in commercial greenhouses. The concentrations of actidione used in these tests ranged from 2½ to 10 p.p.m. It was apparent from the early tests that the young succulent leaves were rather severely injured at 5, 7½, and 10 p.p.m. Mildew, however, was very readily controlled at those concentrations. The older, more mature leaves appeared not to be affected. The youngest leaves showed a certain amount of twisting and bending, somewhat similar to that caused by growth regulators. In addition, many of the leaves became chlorotic and some exhibited small pin-point necrotic areas. The injury to the leaves appeared to vary, depending upon variety and environmental conditions. If application

of actidione was followed by sunny days, the extent and intensity of injury were increased.

Experiments were then conducted, using actidione at 2½ p.p.m. It was apparent that mildew could be controlled very satisfactorily at this concentration, but even at 2½ p.p.m. some injury to the new foliage was evident.

TREATMENT OF OTHER PLANTS

A wide variety of greenhouse plants were then treated with actidione at 7½ p.p.m. to see what possible toxic effect it might have on the foliage. It was believed that at 7½ p.p.m., powdery mildew could be easily controlled, the only question being its toxic effect on the plants.

EFFECT OF ACTIDIONE ON GROWTH OF PATHOGENIC FUNGI IN CULTURE

One of the methods used in evaluating fungicidal materials is to grow pathogenic species on a medium which contains a known concentration of the material (2). An experiment was conducted, using 10 pathogenes growing on potato dextrose agar with concentrations of 0, 1, 5, 10, 20, and 100 p.p.m. of actidione. Linear growth of the

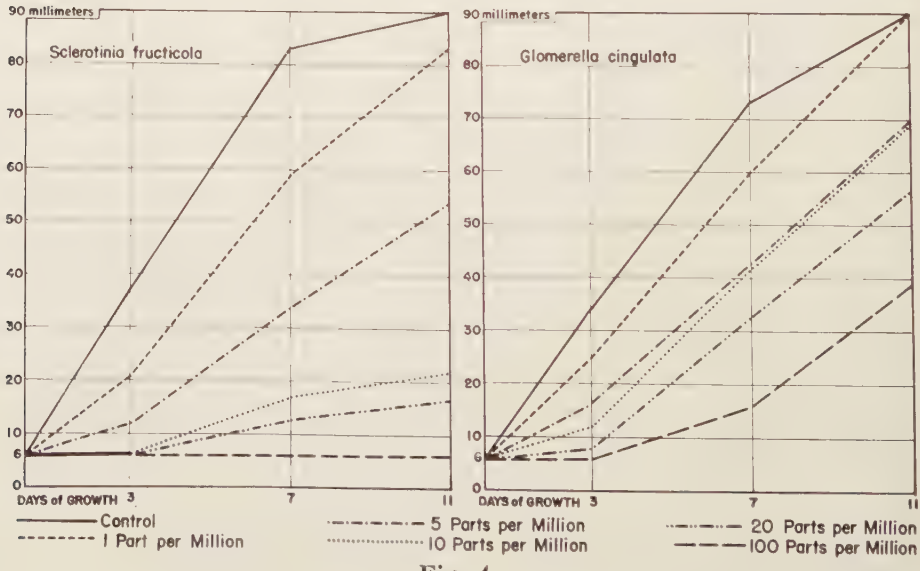

Fig. 4.

colony was measured at intervals and the experiments were run for 11 or 12 days. Each measurement of growth represents the average for four plates. Figures 4 to 8, inclusive, show graphically the results of this experiment.

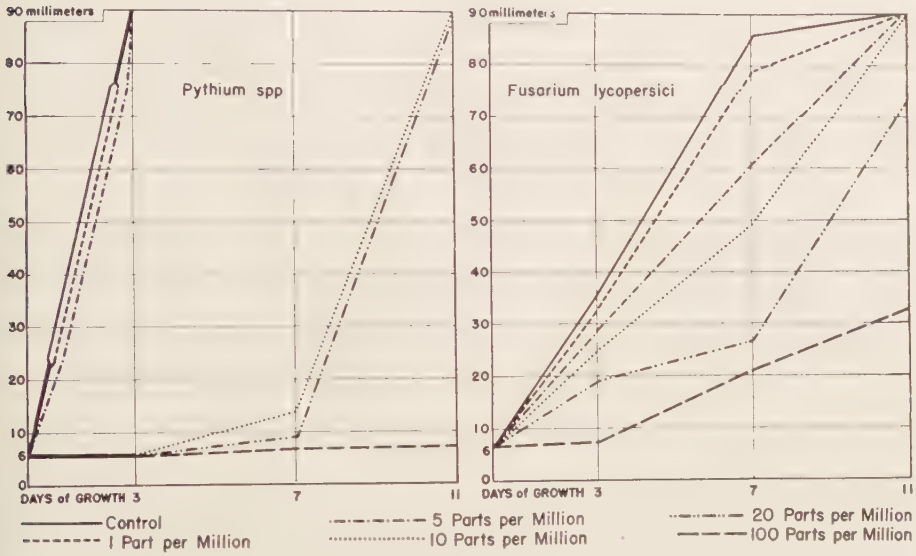

Fig. 5.

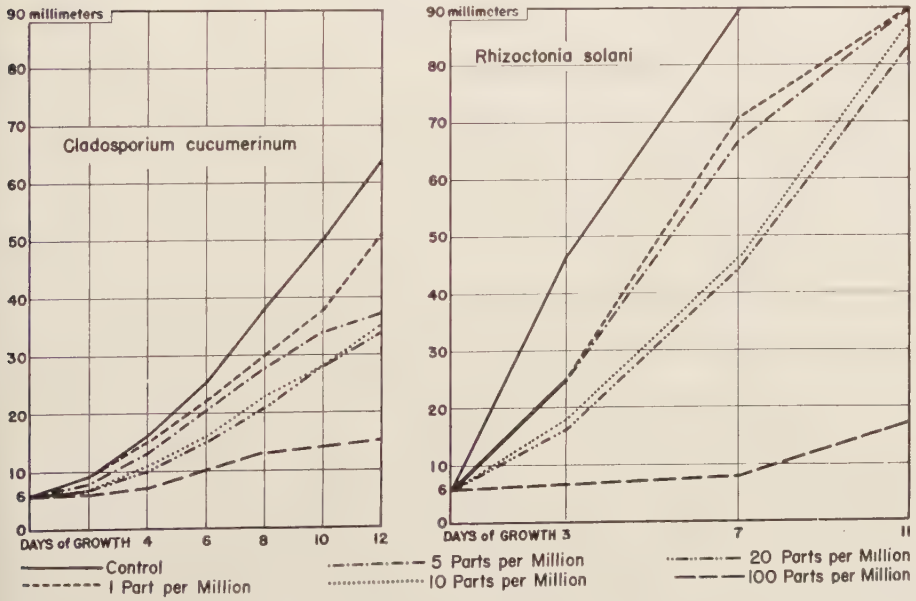

Fig. 6.

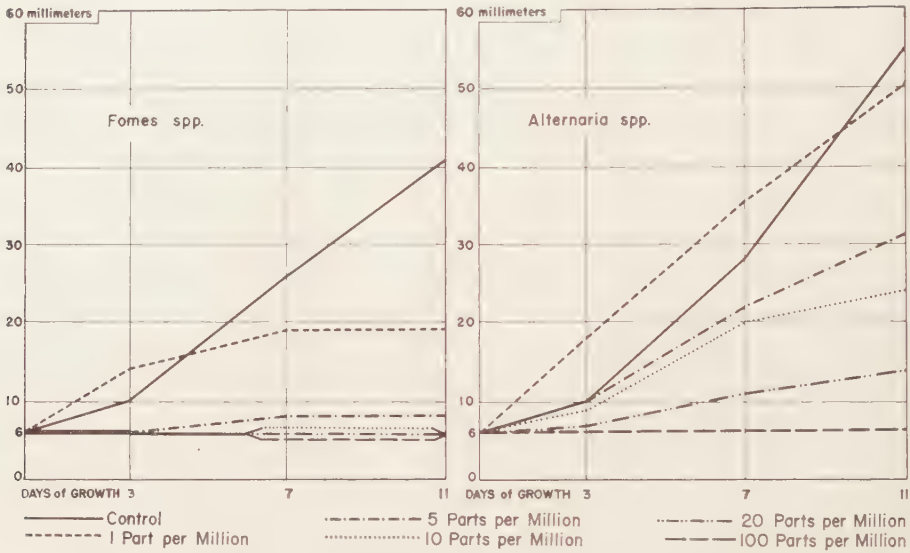

Fig. 7.

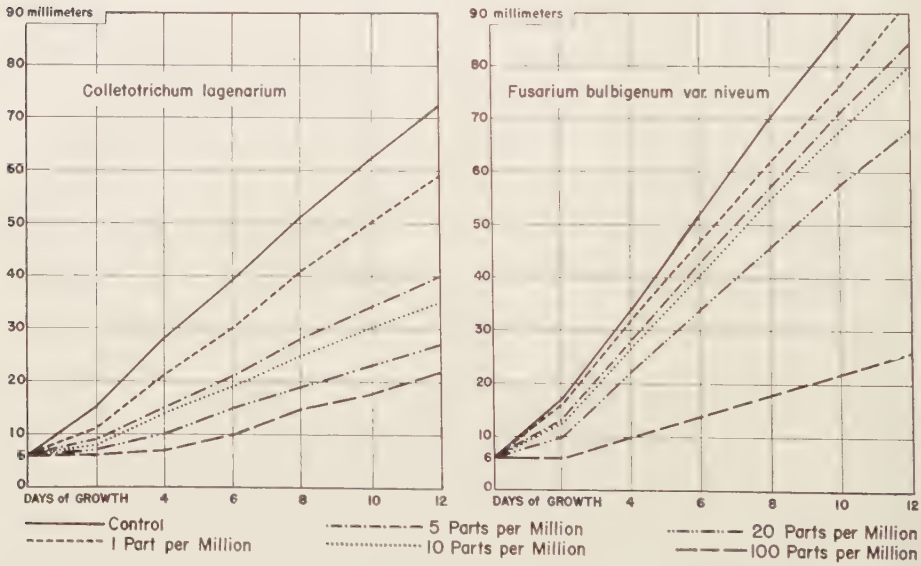

Fig. 8.

All of the fungi were affected by the presence of actidione in the medium, but some were more affected than others and some affected only by the highest concentrations. Among those showing a striking response were *Sclerotinia fructicola*, the cause of brown rot of stone

fruits; *Cladosporium cucumerinum*, cause of scab of cucumbers; *Fomes sp.*, a wood-rotting fungus; *Alternaria sp.*, pathogenic on tomatoes; and *Colletotrichum lagenarium*, cause of cucumber anthracnose. All of the ten species used were inhibited by the 100 p.p.m. concentration and the above-mentioned fungi were inhibited more or less by all of the concentrations.

These results are, of course, preliminary, and laboratory assay is only an indication of use in the field. Field tests will be conducted during the coming season on some of these diseases and laboratory assay is continuing against other pathogenic species. From the laboratory assay, it can be generalized that actidione certainly has fungistatic properties and is worth further testing. The results of tests of phytotoxicity have been variable and the action of the material against fungi is also variable. This is true of several of the newer organic fungicides, and is not a surprising result.

DISCUSSION AND CONCLUSIONS

The new antibiotic material, actidione, controls mildew under greenhouse conditions on beans and roses. On beans there is no sign of toxicity at concentrations of 10 p.p.m. or lower, and control is obtained at 10 p.p.m. On roses there is control of the mildew but the phytotoxicity is much more pronounced. This injury has been observed to vary from variety to variety and with the environmental conditions after spraying. Injury is much less severe on older foliage than on young foliage and control can be obtained on roses by spraying with concentrations of less than 5 p.p.m. Before growers try the material on a large scale, more intensive experiments should be done to clarify the matters of timing of sprays; use of spreaders, stickers, etc.; and the toxicity to various rose varieties.

There is also a variation in the toxic properties of actidione to seeds when they are soaked in various concentrations of the material. Variations in phytotoxic activity is to be expected and extensive tests against many crops are being conducted.

The growth of pathogenic fungi on a culture medium containing actidione indicates strong inhibition of 10 different pathogenes at concentrations of 100 p.p.m. of actidione. Several fungi are markedly inhibited by concentrations as low as 5 p.p.m. Although such a laboratory assay is indicative of a trend only, it can be concluded that the

material is worthy of extensive testing against plant disease fungi, both in the laboratory and in the field.

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A COMPARISON OF SEGMENTED WITH NATURAL SUGAR-BEET SEED

By L. S. ROBERTSON, R. W. BELL, R. L. COOK, and H. W. FAIRCHILD

Sections of Soil Science and Farm Crops

There was published in 1945 a report[1] of the results of one year's comparison of segmented (or sheared) sugar-beet seed with natural (or whole) sugar-beet seed. This experiment was continued in 1946 and 1948. The following constitutes a report of the findings covering the three years.

The comparisons of segmented and natural seed were conducted in connection with the Ferden Rotation Experiment. Comparisons were made between the two types of seed on the following bases: seed germination, pre-blocking stand, post-thinning stand, number of marketable beets, acre-yield and labor requirements in thinning.

PROCEDURE

The experiment comprised 56 beet plots, each 14 feet wide by 90 feet long. Each plot contained 6 rows of beets spaced 28 inches apart. All plots received row applications of 2-16-8 fertilizer at planting time, half of them at the rate of 500 pounds per acre, the other half at 200 pounds per acre. A detailed description of the Ferden Rotation Experiment is published elsewhere.[2]

The soil, a Brookston sandy clay loam, was drained by both tile and open ditches. In spite of this, internal soil drainage was slow because of a compact subsoil.

Before planting, each plot was split lengthwise. Half (3 rows) was planted with segmented seed and the other half (3 rows) with natural seed. In each of the three years, natural seed was planted at the rate of 11.5 pounds per acre. Segmented seed was planted at three different rates in each of the three years. A commonly-used type of sugar-beet

[1]Michigan Agricultural Experiment Station Quarterly Bulletin, 28 (2): Nov. 1945.
[2]Proceedings American Society Sugar Beet Technologists, 1946.

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drill was employed in planting in 1945. In 1946 and 1948 a Cobbley metering device attached to the same drill was used in planting the segmented seed.

RESULTS

Seed Germination and Pre-Blocking Stands

In 1945 the seedlings from natural seed emerged from the soil about 2 days earlier than did those from segmented seed. In 1946 and 1948 this difference was not detected. No differences in rate of emergence due to rate of fertilizer application were noted. However, after emergence from the soil had taken place, the seedlings on the more heavily fertilized plots grew more rapidly.

Stand counts were made prior to blocking on each 90-foot row of beet seedlings. This was done by laying a 50-inch rule at random against the base of the seedlings and counting the number of one-inch spacings on the rule that included one or more beet seedlings. The number was then multiplied by two. The resultant figure, herein called "germination stand" represents the number of beet-containing inches in 100 inches of row.

In the case of both segmented and natural seed, rate of fertilizer application had no effect upon germination stand.

Table 1 shows the effect of planting natural and segmented seed at varying rates upon germination stand (column 4). As would be expected, in any given year actual germination stand varied directly with the amount of seed planted. However, the data shown offer no positive means of predicting, in any year, the germination stand which will result from planting a given amount of segmented seed. A study of the figures given in Table 1 clearly reveals that conditions favoring germination and emergence were much more pronounced in 1946 than in 1945 and 1948. Interestingly, in no instance did the germination stand equal or exceed 30 percent when segmented seed was planted.

In order to determine the relationship between actual germination stand and potential germination stand, the latter figure was computed, and is shown in the fifth column of Table 1. Such a figure presupposes perfect distribution of the seed in the row and perfect germination and emergence. Obviously, actual germination stands were drastically lower than potential germination stands. In one case (1948, segmented seed at 3.3 pounds per acre), actual germination stand was only 16 percent of the potential germination stand.

Further examination of the field data sheets showed not only low actual germination stands but also uneven distribution of seedlings in the row. This indicates clearly the need for a planter which not only distributes seed uniformly in the row but which also places it in the soil in such a manner as to result in uniform germination and emergence.

Table 1—*A comparison of actual germination stand, potential germination stand and post-thining stand of sugar-beet seedlings grown from natural and from segmented seed*

Year	Type seed	Pounds of seed per acre	Actual germination stand	Potential germination stand	Post-thinning stand*
1945	Natural	11.5	45	100	100
1945	Segmented	6.3	27	100	88
1945	Segmented	3.7	16	91	77
1945	Segmented	2.6	15	64	74
1946	Natural	11.5	60	100	102
1946	Segmented	4.3	29	100	93
1946	Segmented	3.3	23	81	89
1946	Segmented	2.8	18	69	81
1948	Natural	11.5	34	100	103
1948	Segmented	7.4	27	100	101
1948	Segmented	5.9	25	100	101
1948	Segmented	3.3	13	81	78

*Number of beet seedlings per 100 feet of row 3 days after thinning.

Post-Thinning Stands

One hundred beets per 100 feet of row are considered a desirable post-thinning stand in Michigan. The right-hand column of Table 1 shows the post-thinning stands of beets in this experiment. In every treatment the amount of viable seed planted was sufficient to result in a uniformily spaced post-thinning stand of 100 or more beet seedlings per 100 feet of row. It will be noted that the use of natural seed planted at the rate shown resulted in an adequate post-thinning stand. This was not always true when segmented seed was planted.

In 1948, adequate post-thinning stands were obtained on plots in which the germination stand was 25 or more. In 1945 and 1946, germination stands of 27 and 29 resulted in post-thinning stands of only 88 and 93, respectively. This can best be explained by the fact that the same field workers were employed for blocking and thinning in 1945 and 1946. Another set of workers was employed in 1948. This emphasizes two things, namely: 1) germination stand cannot be regarded as a

figure whereby post-thinning stand, as accomplished by different workers, can accurately be predicted, and 2) the possibility of encouraging workers to space some beets at intervals closer than 1 foot in order to leave 100 beets per 100 feet of row.

Rate of fertilizer application had no effect on post-thinning stand.

Marketable Beets

Under Michigan conditions the number of marketable beets per 100 feet of row at harvest time seldom equals the post-thinning stand. Disease, mechanical injury and low soil productivity are common reasons for the failure of beet seedlings to reach marketable size. The relationships which existed between post-thinning stands and numbers of marketable beets are shown in the sixth column of Table 2. On the average, only 80 percent of the seedlings constituting the post-thinning stand attained marketable size in this experiment. In two seasons, 1945 and 1946, the percentage of beet seedlings attaining marketable size was greater in the segmented-seed plots than in the natural-seed plots. In 1948 this relationship was reversed. It appears that there is little basis for the belief that seedlings from segmented seed possess greater "livability" than those from natural seed.

Rate of fertilizer application had no effect upon percentage of beet seedlings reaching marketable size.

Sugar-Beet Yields

The right hand column of Table 2 shows the yields of sugar beets obtained from the various treatments. In 1945 beets grown from segmented seed outyielded those grown from natural seed. The yield difference was not great, although statistically significant at the 5 percent level. In 1946, 84 marketable beets grown from segmented seed outyielded 90 marketable beets grown from natural seed. In 1948 beets grown from natural seed outyielded those grown from segmented seed, although the differences were statistically non-significant because of great variation in plot yields. No conclusion can be drawn from the data concerning relationships between type of seed planted and acre yields. However, it is generally agreed that there exists in sugar beets a direct correlation between stand and acre-yield, provided the stand does not exceed 90 to 100 beets per 100 feet of row at harvest. If this is the case, the data herein presented strengthen the belief that, stand for stand, beets grown from segmented seed will yield as much, or

more than those grown from natural seed. In general, the figures also emphasize the importance of attaining high post-thinning stands when segmented seed is planted.

Table 2—*The effect of seed type and rate on post-thinning stand, number of marketable sugar beets and sugar beet yields*

Year	Type seed	Pounds of seed per acre	Post-thinning stand*	Marketable beets**	Marketable beets ÷ post-thinning stand	Yield—tons per acre
1945....	Natural.....	11.5	100	65	.65	4.8
1945....	Segmented.....	6.3	88	—	—	—
1945....	Segmented.....	3.7	77	56	.70	5.2
1945....	Segmented.....	2.6	74	—	—	—
1946....	Natural.....	11.5	102	90	.88	13.1
1946....	Segmented.....	4.3	93	84	.90	13.3
1946....	Segmented.....	3.3	89	79	.89	12.8
1946....	Segmented.....	2.8	81	76	.94	12.1
1948....	Natural.....	11.5	103	88	.85	10.6
1948....	Segmented.....	7.4	101	81	.80	9.8
1948....	Segmented.....	5.9	101	79	.78	10.1
1948....	Segmented.....	3.3	78	61	.78	9.4

*Beet seedlings per 100 feet of row 3 days after thinning.
**Beets weighing over 3 ounces per 100 feet of row at harvest time.

Labor Requirements in Thinning

The time required to block and thin sugarbeets grown from natural and segmented seed is shown in Table 3. On the average, 16 man-hours were required per acre on the natural-seed plots, whereas only 11.0 hours were required on the segmented-seed plots. This represents a labor saving of 31.3 percent. Herein lies the best reason for using segmented seed in preference to natural seed.

It is interesting to note that the labor saving was greater in 1946 than in 1945, even though the same workers were employed in both seasons and even though germination stands were higher in 1946 than in 1945. The only plausible explanation for this paradox appears to be the probability that those conditions which favor high germination and emergence, also make for uniformity of stand. If this is the case, then the pre-blocking stands of beets were more uniform in 1946 than in 1945 and, consequently, the workers required less time in "making decisions".

TABLE 3—*The amount of time required to block and thin sugar beets grown from segmented and natural seed*

Year	Type seed	Pounds of seed sown per acre	Time required to block and thin one acre	Labor saved
1945	Natural	11.5	17.5 hours	—
1945	Segmented	6.3	13.5 hours	22.9%
1945	Segmented	3.7	12.5 hours	28.6%
1945	Segmented	2.6	10.7 hours	38.6%
1946	Natural	11.5	15.2 hours	—
1946	Segmented	4.3	10.3 hours	32.9%
1946	Segmented	3.3	9.3 hours	36.9%
1946	Segmented	2.8	8.5 hours	43.7%
1948	Natural	11.5	15.3 hours	—
1948	Segmented	7.4	12.4 hours	18.9%
1948	Segmented	5.9	11.6 hours	24.2%
1948	Segmented	3.3	9.9 hours	35.3%

SUMMARY AND CONCLUSIONS

1. A field study of sugar beets grown from natural and from segmented seed was conducted during three different years. Comparisons were made between the two types of seed on the basis of seed germination, pre-blocking stand, post-thinning stand, number of marketable beets, acre-yield and labor requirements in thinning.

2. Type of seed used had no consistent effect upon earliness of emergence.

3. Rate of fertilizer application (200 pounds of 2-16-8 an acre and 500 pounds of 2-16-8 an acre) had no effect upon earliness of emergence.

4. Rate of fertilizer application had no effect upon germination stand.

5. In any given year germination stand varied directly with amount of seed planted. However, the data offer no positive means of predicting germination stand from amount of segmented seed planted.

6. In no instance did germination stand exceed 30 percent when segmented seed was planted.

7. Actual germination stands were drastically lower than potential germination stands for the amounts of seed planted.

8. Figures are presented which show that the relationship between germination stand and post-thinning stand is not constant—probably because of the varying quality of work done by different laborers.

9. Only 80 percent of the seedlings constituting the post-thinning stand attained marketable size (3 ounces or over) at harvest.

10. The data presented do not confirm the belief that seedlings from segmented seed possess greater "livability" than do those from natural seed.

11. Rate of fertilizer application had no effect upon percentage of beet seedlings reaching marketable size.

12. The data presented strengthen the belief that, stand for stand, beets grown from segmented seed yield as much, or more than, those grown from natural seed.

13. On the average, the use of segmented seed resulted in a labor saving of 31.3 percent in blocking and thinning, as compared with the use of natural seed.

AN APPRAISAL OF THE MARKET QUALITY OF MICHIGAN PEACHES
(PROGRESS REPORT)

By M. E. CRAVENS, JR. and H. A. CARDINELL[1]
SECTIONS OF AGRICULTURAL ECONOMICS AND HORTICULTURE

IN 1948, for the third consecutive season[2], receivers and consumers of Michigan peaches were given opportunity to express their opinions on the product which they purchased.

Twenty thousand bushels of peaches were included in the study. The fruit was packed in bushel boxes and ventilated baskets by three fruit exchanges in Berrien County in southwestern Michigan. They were treated prior to shipment by two methods, having the objective of reducing rot and waste, as follows: 1) Dusted with sulfur at the time of brushing, and 2) hydrocooled and treated with a liquid fungicide in a patented machine called an "FMC Stericooler".[3]

Receivers and consumers were asked specifically to comment on degree of ripeness and causes of waste, as outlined on a self-addressed post card included with each package. A reproduction of the card is on page 473.

Each card was numbered and an identifying record made of each shipment as to variety, date of shipment, type of treatment, and other essential shipping-point information. There was no identification to the customer of any of the treatments except for a printed label placed on some of the packages of "stericooled" fruit stating that they had been so treated. Of the 20,000 cards included with the shipments, 944

[1]The authors wish to express appreciation to the personnel of the Sodus Fruit Exchange, The Coloma Fruit Exchange and the Millburg Growers Exchange. These organizations made it possible to have cards placed in peach packs and to obtain information on the destination of a number of carlot and truck shipments. Michigan State College is especially indebted to the 944 dealers and housewives, who took the trouble to fill out and mail the postcards on which this study is based. Gratitude is also expressed to Dr. H. B. Tukey, Head, Department of Horticulture, for critically suggesting improvements in presenting this study.

[2]Cravens, M. E. Jr. and Arthur Mauch, Results of Experiments on Marketing Riper Peaches. Mich. Agri. Exp. Sta. Quart. Bul., 30 (4): 387-406. May 1948.

[3]Stericooling is a hydrocooling process using a chlorine type germicidal agent, "Hypo-clor", in a patented hydrocooler called the "F.M.C. Stericooler." In this process ice water containing the germicidal agent is run over the peaches for cooling and treating purposes. This is in contrast to the usual sulfur dust which is the standard treatment for peaches from packing houses in southwestern Michigan.

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RETAILERS AND HOUSEWIVES!!

During the past few years rot has cost peach dealers and consumers thousands of dollars annually. MICHIGAN STATE COLLEGE is experimenting with means of reducing these rots. This container is a part of the experiment. We want to know how these peaches "held up". Our only check of results under normal "trade" conditions is from the answers to this card. Please fill in the answers to the questions below.

Were these peaches: RIPENESS
Too ripe ☐
Too green ☐
About right ☐

Date of sale or use

Estimated WASTE in package from:
Rot ____ lbs.
Bruise ____ lbs.
____ lbs.

This record is from:
retailer ☐
housewife ☐

Comments:

---

were returned. The replies received from retailers and housewives are given in the Tables.

REPORTS ON RIPENESS

Peaches were much more frequently classed as "too green" than "too ripe" (Table 1). This was especially true for Elberta peaches. With this variety seven times as many dusted and eighteen times as many stericooled peaches were classed "too green" as "too ripe". In the case of the Halehaven variety slightly more of the dusted peaches were reported as being "too green" than those that were stericooled. It was significant that about 60 percent of the buyers of Halehaven and 50 percent of the buyers of Elberta peaches classed them as being "about right", as far as ripeness was concerned.

Housewives less frequently classed peaches as "too ripe" and more frequently classed them as "too green" than did retailers. Since the reports are only from people who bought in bushel units for sale or for processing, these differences are significant. On the other hand, buyers almost never reported favorably on peaches rated as "too ripe". Only one-fourth of the comments on peaches being "too green" were favorable, while about two-thirds of those peaches rated as being "about right", were favorable. Apparently the housewives were think-

TABLE 1—*Peach ripeness rating for sulfur-dusted and stericooled peaches as reported by retailers and housewives*

Degree of ripeness	Packing-house treatment					
	Sulfur-dust			F. M. C. stericooler		
	Replies from			Replies from		
	Retailer	Housewife	All	Retailer	Housewife	All
	(Percent of replies)					
HALEHAVEN						
Too ripe	17	6	9	20	12	16
About right	63	61	61	60	63	60
Too green	18	24	23	12	19	16
Too green and about right	1	5	4	4	3	4
Too ripe and too green	1	3	2	—	3	2
Other	—	1	1	4	—	2
Total	100	100	100	100	100	100
Number of replies	88	229	317	25	32	57
ELBERTA						
Too ripe	10	1	6	4	1	2
About right	51	48	49	59	50	55
Too green	35	48	42	34	40	37
Too green and about right	1	—	1	1	6	4
Too ripe and too green	3	3	2	2	3	2
Other	—	—	—	—	—	—
Total	100	100	100	100	100	100
Number of replies	77	79	156	190	190	380

ing more of the immediate use for peaches, while the retailers were thinking of their ability to keep them until they were completely sold.

There was no apparent relationship between the method of treatment and the rating of ripeness. The dusted Elbertas were rated "too ripe" more frequently than were the stericooled ones, while for the Halehavens the reverse was true.

In several of the shipments which went through the stericooler the degree of ripeness at the time of packing and shipping was noted. The percentage of customers reporting that these peaches were "too ripe" was no different where the peaches were rated "green" when packed than where they were shipped in a "firm ripe" stage (Table 2). The percentage of buyers reporting them as being "too green", however, decreased from approximately 39 percent where "green" peaches were shipped, to about seventeen percent where "firm-ripe" peaches were shipped. The percentage reporting ripeness as being "about right" rose from 50 percent of the peaches shipped in the "green" stage to

TABLE 2—*Ripeness of stericooled Elberta peaches at time of shipping and replies from retailers and consumers concerning ripeness*

What retailers and consumers said	Degree of ripeness when packed*			
	Green	Green to firm	Firm ripe	All
	(*percent of replies*)			
Too ripe	2	4	2	3
About right	50	56	76	59
Too green	39	35	17	33
Mixed	9	5	5	5
Total	100	100	100	100
Number replies	56	128	46	230

*Average pressure as measured by 5 16 inch plunger: green, 25 pounds; green to firm, 18 pounds; firm ripe, 14 pounds.

about 76 percent of those shipped in the "firm ripe" stage. Apparently the peaches classed as "firm ripe" at the time of shipment gave much better satisfaction to the buyers than did either "green" or "green-to-firm" peaches. The fact that wholesale buyers realized this and paid a premium for "firm ripe" over "green" Elberta peaches on The Benton Harbor Wholesale Fruit Market was reported by Hathaway in 1947[4]

WASTE REPORTED BY PURCHASERS

No consistent difference was reported in the amount of waste between the dusted and the stericooled peaches. A very considerable

TABLE 3—*Amount and principal causes of waste in stericooled and sulfur-dusted peaches*

Method	Reported cause of waste*		
	Rot	Bruise	Total
	(*percent waste*)		
HALEHAVEN			
Dusted	7.4	5.4	12.8
Stericooled	10.4	5.4	15.8
Average	8.0	5.4	13.4
ELBERTA			
Dusted	11.8	6.2	18.0
Stericooled	10.4	4.0	14.4
Average	10.8	4.6	15.4

*Waste due to worms and other causes than rot was reported as being less than .05 of one percent.

[4]D. E. Hathaway, "Causes of Difference in Peach Prices on the Benton Harbor Market 1947, Preliminary Report". A. E. 2, August 1948, Agricultural Experiment Station, Michigan State College, East Lansing.

waste was reported for peaches with each treatment (Table 3). Stericooled Elberta peaches were reported with slightly less waste than were the dusted ones, while in the case of Halehaven peaches the stericooled ones were reported as having slightly more waste than the sulfur-dusted peaches. These results are in disagreement with those obtained in 1947 on a smaller number of cases. In the 1947 study the stericooled peaches showed less waste than did the sulfur-dusted ones.[5]

In addition to the data reported in Table 1, one dealer stated that he had made full refund on 122 out of 200 bushels of stericooled peaches he had sold. His description of them was that they turned black inside. These peaches had apparently frozen before he got them and he had bought them without knowing this. Since such an enormous loss was not a direct effect of stericooling and since it would throw the entire series of data out of balance, it was not included in the table. It is, however, one of the facts that must be taken into consideration in employing the stericooling treatment for peaches. This points out the need for instructing shippers and carriers as to the reduced needs for icing and salting in transit for precooled peaches.

Both housewives and retailers reported about the same amount of waste (Table 4). In the case of the Halehaven variety, retailers reported more waste than did housewives, while in the case of the Elberta variety the housewives reported more waste than did retailers. It was interesting to note that in the case of the Halehaven peaches comments from housewives were much more favorable than comments

TABLE 4—*Amount and cause of waste in percentage reported by different types of buyers*

Type of buyer	Reported cause of waste		
	Rot	Bruise	Total
	(percent waste)		
HALEHAVEN			
Retailer	9.8	5.2	15.0
Housewife	7.0	5.6	12.6
Average	8.0	5.4	13.4
ELBERTA			
Retailer	10.4	4.4	14.8
Housewife	11.4	4.8	16.2
Average	10.8	4.6	15.4

[5] See footnote 2.

TABLE 5—*Buyers rating of ripeness of peaches and percentage waste reported*

Reported ripeness	Reported cause of waste		
	Rot	Bruise	Total
		(*percent waste*)	
HALEHAVEN			
Too ripe	19.4	7.8	27.2
Mixed ripe and green	12.0	11.0	23.0
Too green	10.0	6.0	16.0
About right	4.6	4.4	9.0
Green and about right	4.4	3.0	7.4
Average	8.0	5.4	13.4
ELBERTA			
Too ripe	24.6	6.0	30.6
Mixed ripe and green	18.0	9.8	27.8
Too green	15.2	4.6	19.8
Green and about right	12.0	5.2	17.2
About right	5.6	4.2	9.8
Average	10.8	4.6	15.4

by retailers, while in the case of Elberta peaches the comments from housewives were less favorable than those from retailers. The cause, and particularly the amount, of waste and associated quality factors apparently had a considerable effect on the way these two types of buyers rated the peaches.

The comments on the stericooled peaches were somewhat more favorable than those on the dusted peaches. These more favorable replies and comments were due more to factors of quality than to freedom from rotting.

When the replies were grouped on the basis of the reported ripeness as stated by the buyer, wide variations were noted in the amount of waste. This waste was greatest in the case of peaches marked, "too ripe" by the buyer, and least in peaches marked, "about right" (Table 5). In the case of peaches rated as, "too ripe" the average waste was over one-fourth of the peaches in the basket while in the case of peaches rated, "about right", less than one-tenth was reported as the average waste. The greatest amount of bruising was found in peaches which customers marked as being "mixed ripe and green". In the case of peaches reported as being "mixed-ripe and green" the amount of bruising was almost double the average given for the four other groups. This mixing of peaches of different degrees of ripeness in the same container appears to greatly aggravate bruising.

Approximately one-third of the total waste reported by these buyers was blamed on bruising, and two-thirds on rotting. The number of

TABLE 6—*Range in the percentage waste caused by rots and bruises as reported by retail peach buyers*

Percentage waste	Halehaven		Elberta				Average
	Shipper No. 1		Shipper No. 1		Shipper No. 2	Shipper No. 3	
	Dusted	Stericooled	Dusted	Stericooled	Stericooled	Dusted	
	(percent of replies)						
ROT							
Under 2 percent	38	35	44	42	41	31	39
2-6	30	22	15	18	31	20	24
7-12	12	7	13	13	11	9	12
13-19	6	3	8	4	4	4	5
20 and over	14	33	20	23	13	36	20
Total	100	100	100	100	100	100	100
BRUISE							
Under 2 percent	43	54	58	59	45	31	49
2-6	30	19	25	24	32	26	27
7-12	12	10	6	11	13	20	12
13-19	4	2	3	2	5	3	3
20 and over	11	15	8	4	5	20	9
Total	100	100	100	100	100	100	100
TOTAL WASTE							
Under 2 percent	20	19	29	27	19	13	22
2-6	28	24	17	19	30	17	24
7-12	15	13	15	17	21	13	16
13-19	10	3	7	8	10	11	9
20 and over	27	41	32	29	20	46	29
Total	100	100	100	100	100	100	100

pounds variation in waste reported as due to rots was much greater than that due to bruises.

The variation in waste reported by buyers of both Halehaven and Elberta peaches showed a wide variation. Almost two-fifths of the buyers reported less than one pound of waste per bushel due to rot (Table 6). On the other hand, one-fifth reported 20 percent or more waste due to rot. Such wide variation in waste due to rot suggests the need for more information concerning methods now used for controlling rot. If one-third of the peaches can be marketed with no more rot than one pound per bushel it should be possible for more to be as successfully grown and handled by the same methods.

Almost one-half of the growers shipped peaches in which the waste due to bruising was reported as being less than one pound per bushel,

or 2 percent. Those that showed more than 20 percent waste due to bruising represented about one-tenth of the total shipped. Here again the bulk of the shippers were satisfying their customers and it is possible that others could do likewise by following the same practices. Degree of fruit hardness and uniformity of firmness are important factors. Bruising can occur and reoccur anywhere between the picking of the fruit and the time when it is used.

Total waste varied from none to the loss of an entire bushel due to rotted and bruised fruit. Again, close to one-fifth of the lots shipped reached the customers with less than 2 percent waste, while another 25 to 30 percent had over one-fifth waste. A study of the reasons for these wide variations in waste should throw considerable light on the methods needed to control it.

DISTANCE PEACHES WERE SHIPPED

Over 80 percent of these peaches were sold within 650 miles of Benton Harbor, Michigan (Table 7). The stericooled peaches were shipped considerably farther than were the sulfur-dusted peaches. Stericooled peaches were practically all shipped under refrigeration, while a large part of the sulfur-dusted peaches were transported by truck and often without refrigeration. This difference in method of shipping might have more than offset the effect of normal deterioration due to the greater distance. A comparison of the waste due to rots and bruises, for peaches shipped varying distances, showed no consistent difference between them for each treatment. The lowest waste, both in Halehaven and Elberta peaches, was found in the shipments going more than 650 miles. There are, no doubt, many reasons for this. Brokers as well as owner-buyers usually demand the firmest

Table 7—*Distance from which post cards were returned*

Miles	Shipper No. 1				Shipper No. 2	Shipper No. 3	Total
	Halehaven		Elberta		Elberta	Elberta	
	Dusted	Stericooled	Dusted	Stericooled	Stericooled	Dusted	
	(percent of replies)						
Under 250 miles.	47	14	24	10	4	61	27
251-650 miles ...	41	62	65	71	85	39	60
651-1050 miles ..	12	24	11	4	11	—	9
1051 and over...	—	—	—	15	—	—	4
Total.....	100	100	100	100	100	100	100

peaches for their longest shipments. Packing-house supervisors often give out special instructions to "tighten-up" on all sorting and packing standards when a particular shipment is being packed. Shippers of "long-haul" fruit usually use the best insulated and refrigerated trucks or cars with built-in fans. Experienced brokers insist that precooling fans be used for an adequate length of time before cars are shipped. In recent years some buyers have specified that their loads be hydro-cooled, wherever a "Stericooler" was available. If one or more of these probable factors were not operating, one would expect that shipments traveling more than 650 miles would show the greatest waste. That such was not the case, indicates that better fruit and conditions must have been afforded than in the case of short-haul shipments. This is interesting and significant, because a similar study[1] was reported exactly one year ago. Peaches from the same packing-houses were reported as showing 20 percent waste, when shipped less than 400 miles and requiring an average of 3 to 4 days between shipping and consumption. On the other hand, peaches that were shipped "400 miles and over", requiring an average of 9.2 days, were reported as having only 16 percent waste.

Several studies have shown that adequate refrigeration effectively controls rots until the car reaches its destination. Voluntary replies of the type of postcard used in this study, where the ultimate sale or use is determined, makes possible the study of the effect of refrigeration, maturity of fruit and handling methods, on waste to the last step in the marketing process. It also allows for answers on factors other than waste. For refrigeration to be effective in the control of rots and other causes of waste, it must not permit an unfavorable quality. Such remarks as "rot before ripening", "cling to the pit", and other statements may be due partly to refrigeration before proper ripening. In this case, it is not refrigeration that is at fault but degree of ripeness and other harvesting and handling factors. In order to use refrigeration, stericooling and other methods of precooling and cold storing effectively, it will be necessary to re-examine maturity and handling procedures from the field to the packing house. Judging from the bitterness of the remarks from some of the customers, the sooner such an evaluation of harvesting and marketing methods is made the better it will be for the peach industry in Michigan.

[1]See footnote 1.

DISCUSSION

Other factors were more important in the control of peach rot than was refrigeration or stericooling. Tests made in 1948 indicated that at the present stage of development of refrigeration, stericooling or dusting with a fungicide for the control of rot cannot offset the bad effects of unsound production and handling practices. Such packing-house treatments offer a "last stand" before fruit goes to market. These treatments are not cure-alls for the control of rot. On the other hand, the stericooling process offers a means of taking the field heat out of the peaches in a very short time without any deleterious effect upon the fruit.

The large variations in waste reported suggest the possibility of determining the factors affecting waste by studying a large number of cases in which production, harvesting and packing practices are known. Since many growers and shippers are shipping peaches with a low amount of rot, a study of factors involved might be expected to reveal practices that would be effective for growers who now produce peaches that rot very badly.

The fact that between 50 and 60 percent of the replies indicated that peaches were "about right", as far as ripeness was concerned is quite encouraging. On the other hand, it indicates the need for continued attention to harvesting peaches at the proper stage of maturity. The bad showing of peaches of mixed ripeness indicates the need for more attention to picking and packing peaches of more uniform maturity.

The small amount of data where the ripeness in shipping was known, suggests the importance of packing a mature or firm ripe peach if consumers are to be satisfied.

WEED COMPETITION IN SMALL GRAINS IN THE UPPER PENINSULA

By A. R. WOLCOTT and R. F. CARLSON
SECTIONS OF FARM CROPS AND HORTICULTURE

THE IMPORTANCE OF controlling such conspicuous broad-leaved weeds as mustard and thistle in grain fields is fully appreciated by upper peninsula farmers. Even so, the extent to which grain yields are reduced by weed competition is generally underestimated. Particularly is this true when the competing species are grasses whose presence in the grain easily escapes attention.

Quack grass *(Agropyron repens L.)* is an aggressive perennial grass, the control of which is a major item in the cost of crop production in many areas in Michigan. In spite of the high cost of controlling it for row crops, a philosophy of "living with quack grass" is generally accepted in areas where it is established.

Quack grass makes a good quality hay when cut early, especially when topdressed with nitrogen in the spring. Good potato yields follow breaking up of a quack grass sod. In the Upper Peninsula summer fallow at frequent intervals following hay harvest is designed to give only temporary control. For spring grains the land is then plowed in the fall to expedite seed bed preparation in the spring. For potatoes the summer fallowed land is usually not plowed until the following spring. Good seedbed preparation and frequent early cultivation give control in the potatoes.

Under either of the above cropping programs, however, re-encroachment of quack grass begins in the first grain crop and continues through the rotation. Most hay meadows in their first year contain from 20 to 50 percent quack grass, regardless of the forage species seeded.

Casual observation of the rapidity with which a stubble-field greens up with quack grass as soon as the grain is removed—where only a few spears of grass were observed in the grain—will suggest that consider-

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able unseen growth of rhizomes has taken place. Little consideration is given to the extent to which this subsurface development competes for moisture and nutrients with the grain crop.

That this competition may be considerable is indicated by data gathered at the Upper Peninsula Sub-station at Chatham for purposes of estimating the extent to which weed competition reduces small grain yields.

PROCEDURE

Four areas were selected in a field of oats where it was possible to take paired samples out of a patch infested with quack grass and out of the adjoining quack-grass-free area. Four samples (1/5 rod square) were cut out of the grass-infested patches, taking all surface growth. Four corresponding samples were taken out of the adjoining grass-free areas.

The quack grass was separated from the grain and the green material weighed. The samples of grass and grain were dried and weighed again, after which the grain was threshed, and the threshed grain weighed.

Four pairs of samples were similarly treated from four areas in a field of mixed oats and barley where patches of Canada thistle *(Cirsium arvense L.)* were surrounded by areas of clean grain.

TABLE 1—*Effect of quack grass and Canada thistle growing in grain on total yields of surface plant material and surface dry matter and on the yield of threshed grain*

Crop	Green plant material			Dry matter			Threshed grain	
	Total weight grams per plot	Gain over check	Weeds	Total grams per plot	Gain over check	Weeds	Yield per acre	Reduction in yield of check
	grams	*percent*	*percent*	*grams*	*percent*	*percent*	*bushels*	*percent*
Oats	1,310	.....	.....	719	.....	.....	89	.....
Oats plus quack grass	1,104	13 less	28 (quack grass)	617	12 less	23 (quack grass)	62	30
Oats and barley	880	.....	.....	534	.....	.....	65	.....
Oats and barley plus Canada thistle	1,275	46 more	53 (thistle)	538 more	1.0 more	34 (thistle)	45	30

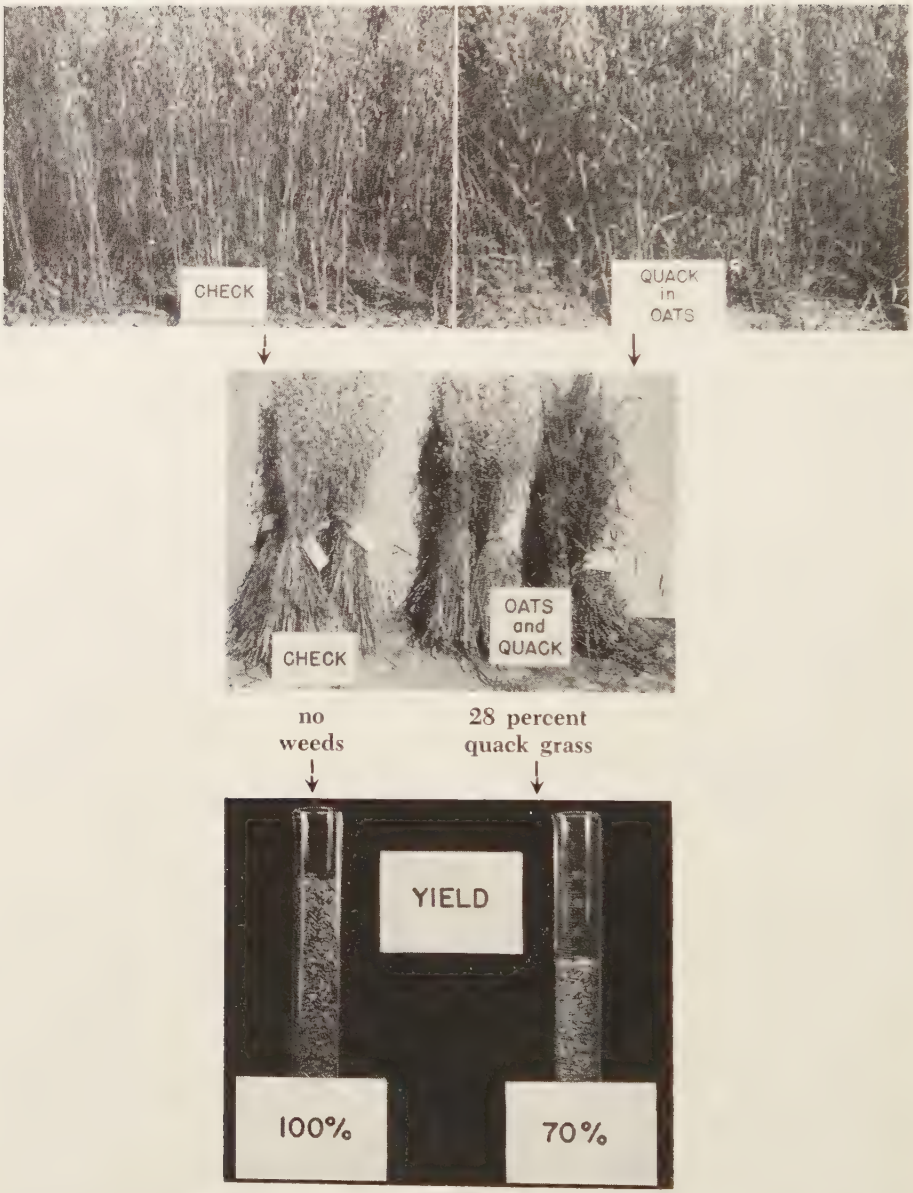

Fig. 1. Top two photographs compare appearance in the field of a stand of grain without weeds (left) with a stand containing 28 percent quack grass (green weight basis) on the right.

Center photo shows the harvested green plant material after quack grass had been separated from the oats. Total weight of oats and quack (right) was 13 percent less than weight of oats alone grown on an equal area without weed competition (left).

Bottom photo shows proportionate yields of threshed grain from the two areas.

Fig. 2. Top two photos compare appearance in the field of a stand of grain without weeds (left) with a stand containing 53 percent Canada thistle (green weight basis) on the right.

Center photo shows the harvested green plant material after the thistles had been separated from the grain. Total weight of grain and thistles (right) was 46 percent greater than weight of grain alone grown on an equal area without weed competition (left).

Bottom photo shows proportionate yields of threshed grain from the two areas.

The data summarized in Table 1 are based on the averages of four samples for each determination.

Figures 1 and 2 show the effect of quack grass and Canada thistle on grain yields.

RESULTS

1. Quack grass growing in competition with grain reduced the total weight of green plant material produced above ground by 13 percent, while thistles increased green surface growth by 46 percent.

2. The dry matter produced as surface growth on these same plots was reduced 12 percent by quack grass, and increased slightly by thistles.

3. An apparent 28-percent infestation of quack grass (based on green plant material) reduced grain yields as much as a 53-percent infestation of Canada thistle. The reduction of grain yields in both cases was 30 percent.

4. In the case of quack grass, the percentage reduction in yield was greater than the percentage of surface dry matter produced as quack grass. With thistles this relationship was reversed.

DISCUSSION AND CONCLUSIONS

Casual observation supported by the foregoing data indicates that when quack grass grows in grain the total tonnage of surface growth is reduced—a situation not observed nor indicated by the data for Canada thistles growing in grain. This may be due partly to the fact that the much deeper root system of thistles draws for nutrients and moisture from a larger soil volume than either grain or quack grass. However, observations in the field support the further conclusion that when surface growth of quack grass in cultivated fields is partially suppressed by crowding and shading by competing species, a small amount of surface growth will support a large amount of rhizome development.

This unseen subsurface growth has generally been ignored in discounting the effect of relatively light infestations of quack grass—as judged by observation of surface growth—in reducing grain yields.

The data indicate that the effect of quack grass in reducing yields is often underestimated.

Grains, being grasses themselves, afford concealment for significant infestations of quack grass, as is shown in the series of pictures in

Fig. 1. Thistles, with their spectacular flowering and fruiting habits are very conspicuous in a grain field (Fig. 2). The average farmer ignores the grass, which may infest his whole grain acreage, while he goes to great pains to stamp out the thistles which usually occur only in scattered patches.

Yet, the data presented indicate that, on a given soil, on either a green weight or a dry matter basis, production of a given weight of surface plant material as quack grass may reduce grain yields more than production of an equivalent weight of surface plant material as thistles.

The quack grass infestation on the plots harvested in this study was not extreme. The "quack" areas were detected only by walking through the grain.

JOURNAL ARTICLE ABSTRACTS

Investigations on the Fluorometric Determination of Malic and Succinic Acids in Apple Tissue

Barr, C. G.

Plant Physiology. 23 (4): 443-454. 1948. [*Journal Article 757 (n. s.) from the Michigan Agricultural Experiment Station*]

A photometric method has been developed for the quantitative determination of malic and succinic acids in mixed solutions and in certain plant tissues, outlined as follows:

When heated with resorcinol and sulfuric acid they yield compounds which show intense fluorescence under certain conditions. Fluorometric separation of the succinic-acid and malic-acid derivatives is accomplished by controlling the exciting light and reaction of the test solution. Dilute solutions of the succinic acid derivatives show an intense green fluorescence in acid reaction when illuminated by light of wave length 420 to 520 millimicrons. The malic acid derivative shows virtually no fluorescence under these conditions but fluoresces a brilliant blue in basic solution under ultraviolet light of 320 to 420 millimicrons in length.

Influence of Oil-wax Emulsions Sprays on Size of Montmorency Cherries

Neal, A. L., Gardner, V. R., Barr, C. G., Rasmussen, E. J. and Miller, E. J.

Journal of Agr. Res. 77 (9 and 10): 261-270. 1948. [*Journal Article 857 (n. s.) from the Michigan Agricultural Experiment Station*]

Five different oil-wax emulsions containing various proportions of paraffin wax, linseed oil, soybean oil and Bentonite, together with certain emulsifying agents, were applied as sprays to small potted cherry trees in the greenhouse and to bearing cherry and apple trees in the orchard. The greenhouse applications resulted in significant reductions in transpiration rate. The orchard applications resulted in significant increases in size of the fruit in the case of the cherries. Presumably these were associated with decreases in transpiration rate. The results obtained with apples in the orchard were variable.

The Effect of Certain Chemical Agents on the Virus of Newcastle Disease of Chickens

Cunningham, C. H.

Jour. Vet. Res. 9 (31): 195-197. 1948. [*Journal Article 892 (n. s.) from the Michigan Agricultural Experiment Station*]

A number of chemical agents were tested for their effect on an egg-propagated strain of the virus of Newcastle disease of chickens during an exposure period of three minutes. Following the exposure period, the virus-chemical mixture was injected into the allantoic cavity of embryonated chicken eggs. Some of the mixtures were injected into the egs directly while others were diluted with sterile distilled water to a chemical concentration which previous experiments had shown to be nontoxic for embryos. Survival of the inoculated embryos for six days was considered as evidence that the material injected did not contain active virus.

The following preparations were effective against the virus in three minutes or less: ethyl alcohol, 95 and 70 percent; tincture of iodine, 2.5 and 1.0 percent; phenol 3 percent, liquor cresolis saponatus, 3 and 1 percent; lysol, 3 and 1 percent; creoline Pearson, 3 and 1 percent; potassium permanganate, 1:1,000; lysol, 3 and 1 percent; mercuric chloride, 1:1,000; sodium hydroxide, 5 and 2 percent; clorox, 20 and 5 percent; Disilyn, 1:512; Roccal, 1:1,000; tincture of metaphen, 1:200; tincture of zephiran, 1:1,000; phemerol, 3 and 1 percent; and formalin, 10 percent.

The following preparations were without effect on the virus during the three-minute exposure period: ethyl alcohol, 40 and 25 percent; tincture of iodine, 0.1 and 0.01 percent; phenol, 1 percent; potassium permanganate, 1:10,000; mercuric chloride, 1:10,000; sodium hydroxide, 1:10,000; clorox, 1 percent; quarternary ammonium compound number 2, 1:10,000; tincture of metaphen, 1:20,000; tincture of zephiran, 1:100,000; merthiolate, 1:1,000 and 1:10,000; formalin, 1.0 and 0.01 percent; and boric acid, 4 percent.

Green Tissue Testing with the Spurway Soil Testing Equipment as an Aid in Soil Fertility Studies

COOK, R. L., ROBERTSON, L. S., LAWTON, KIRK, AND ROOD, P. J.

Soil Sci. Soc. of Am. Proc. 12: 379-381. 1947. [*Journal Article 914 (n. s.) from the Michigan Agricultural Experiment Station*]

The testing of green plant tissue is recognized as a valuable aid in soil fertility investigations. The Spurway soil testing equipment described in Michigan Agricultural Experiment Station Technical Bulletin 132 (3rd. revision) 1944, has been used successfully for testing green plants. Directions are given for making such tests. It is advisable to keep green tissue tests on a comparative basis, always comparing test results from unknown plants with those from plants known to be normal.

Tests were conducted to prove the validity of results obtained by analyzing green tissue with the Spurway equipment. In the greenhouse it was possible to predict from tissue tests which plants had received sufficient ammonium nitrate for maximum yields and which were starved for nitrogen.

In field experiments with alfalfa and clover it was possible in most cases, by either the phosphorus or potassium test, to distinguish between treated and untreated plots and between plots treated only with phosphorus or only with potash. Thus the method was shown to be very sensitive and reliable as an indication of the supply of nutrients in the soil for a certain plant at that particular time.

A Study of Correlation Between Rapid Soil Tests and Response of Legume Hay to Phosphorus and Potassium Fertilization on Some Michigan Soils

LAWTON, K., ROBERTSON, L. S., COOK, R. L., AND ROOD, P. J.

Soil Sc. Soc. Am. Proc. 12: 353-358. 1947. [*Journal Article 915 (n. s.) from the Michigan Agricultural Experiment Station*]

Fertilizer plots designed to study correlation between crop yield and rapid soil tests were laid out at 66 locations on established alfalfa stands in lower Michigan in 1946. Soil samples were taken before treatments were applied and at the harvest time of first cutting over a two-year period. Four rapid soil testing methods were compared.

Application of 150 pounds per acre of P_2O_5 and K_2O alone and in combination resulted in an average increase in yield of 34 and 52 percent, respectively, for phosphate and phosphate-potash treatments in 1946. Little benefit was found

from potash applied alone. Over 90 percent of the experiments showed a significant increase in yield of the phosphate-potash treatment over the check. The results of 55 experiments continued in 1947 were similar to those of the previous year, though crop response to all treatments was lower.

Linear correlation between hay yields and four different rapid soil testing systems was found to be of limited value in predicting yield response from soil tests. The prediction of significant yield response of hay from fertilizer using narrow and critical nutrient levels was found to be from 70-80 percent accurate in the case of phosphorus. For potassium this accuracy was from 55-65 percent. Discrepancies are attributed to varying seasonal weather conditions, wide variation in soils studied as regards texture, organic matter content, and pH, and differences in the composition of the hay crop.

A separation of the soil studied into three textural-drainage groups facilitated the establishment of more accurate soil test-crop response levels. No specific soil testing system was noted to be substantially superior to the others under observation, if adequate soil and plant data relative to crop response to fertilizer was available.

Tests in 1947 Against the Two-Spotted Spider Mite

SHERMAN III, FRANKLIN, AND KING, H. L.

Jour. Economic Entomology. 41 (5): 807-808. 1948. [*Journal Article 922 (n. s.) from the Michigan Agricultural Experiment Station*]

In six series of single-spray tests conducted in Michigan apple orchards, parathion gave outstanding control of the two-spotted spider mite, *Tetranychus Bimaculatus* Harvey. Used as a summer spray at the rate of 2.5 pounds of 25 percent wettable powder, this material killed practically all of the mites present at the time of application and left a residue which killed mites hatching after the treatment. The dicyclohexylamine salt of dinitro-o-cyclohexyl phenol, tetraethyl pyrophosphate and hexaethyl tetraphosphate were somewhat less effective than parathion and did not exhibit any residual effect. Bis(p-chlorophenoxy) methane was ineffective.

The Control of Red-banded Leaf Roller with Parathion

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Jour. Economic Entomology. 41 (6): 976-977. 1948. [*Journal Article 929 (n. s.) from the Michigan Agricultural Experiment Station*]

In replicated orchard treatments 4 cover sprays of O,O-diethyl, O-p-nitrophenyl thiophosphate (parathion) used at the rate of 0.6 pound per 100 gallons of water gave excellent control of red-banded leaf roller on Cortland, Snow and Jonathan apples, but not significantly better than 3 pounds of lead arsenate or 0.25 pound of parathion. The amount of 0.75 pound of DDT gave inferior control. Wettable powder formulations containing 15 and 25-percent parathion gave similar results when used at equivalent concentrations. Spray applications caused no significant change in yield, and no spray injury was observed. Chemical analyses indicated negligible residues of parathion 3 weeks after spraying.

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